

FOREST ECONOMICS PLANNING & MANAGEMENT

BY
L.C. SHARMA

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Preface

“Among the scenes which are deeply impressed on my mind, none exceeds in sublimity the primeval forests undefaced by the hand of man. No one can stand in these solitudes unmoved, and not feel that there is more in man than the mere breath of his body”—Charles Darwin Journal during the voyage of H.M.S. Beagle.

A number of forces, viz., growth of population, development of civilization, changing standard of living, vast spread of education and so on, are bound to put great pressure on the forest land and forest resources. A large number of persons every year become helpless victims of floods, landslides, and droughts occurrence of which has become more frequent because of indiscriminate and reckless felling of trees and denudation of forests by the invaders of forest wealth, without employing scientific methods. A forest takes a number of years to grow and mature to harvest but only a few days to be destroyed. A timber tree which takes one hundred years to attain maturity is reduced merely to a stump hardly in an hour. Under such trying conditions, the forest wealth cannot remain inexhaustible, however, bountiful Nature might be in replenishing them. It is therefore essential that this scarce resource should be utilised to its optimal in a discreet manner. The forester who is mainly taught the theory and practice of pure forestry, at times finds himself somewhat lost in the ocean of the economic problems connected with forests. It is therefore advisable to lay adequate emphasis on the study of economic aspects of forestry in the professional forestry course.

The main purpose of this book is to help the forestry students and practising professionals in applying the tools of economic analysis to the present day complex forestry problems. This book is also expected to help not only the planners in their exercise of planning the country's forest wealth better but the intelligent laymen as well in a better comprehension of an oft-neglected aspect of the forest economy. This study basically highlights the economic aspect of forest resources. It is presumed

that the students for whom this book is especially meant have the primary knowledge of main Principles of Economics, statistics and information are essential prerequisite of an intelligent discussion and understanding of economic problems and hence figures have been freely used to illustrate facts with lucidity. In advanced countries, the Economists have freely applied the analytical tools of general economics to the peculiar problems of forestry but so far the foresters in this country have not by and large taken recourse to these tools. An attempt has been made in this treatise to illustrate the application of techniques of economic analysis to the problems of forestry in their economic aspects. The possibility that all the ideas thrown up in this book might not stand the test of time, but within the limited constraints of time, space and knowledge, this exercise is expected to considerably help in bridging the gap between what is and what ought to be. It is the need of the day that forestry should be regarded as an economic activity. If this book can help the forestry students achieve a better understanding of the subject of forestry in relation to society for obtaining optimum usage of forest resources and can stimulate fresh thinking in that direction, the purpose of this book will have been adequately served.

A special debt of gratitude is due to Dr. J.C. Westoby, Director Forestry Division, F.A.O., Rome who has read the whole manuscript and has made many valuable suggestions on its presentation; to Dr. P.M. Ganapathy, Director, Kerala Forest Research Institute, Peechi; Shri H.P. Sharma, M.A., B.T., Shri R.C. Sharma, I.A.S., Shri T. Kodanramiah, Shri Kamal Kishore, Shri P.S. Awal,—Senior Research Officers, Shri D. Singh and Shri R. Santanam, Shri J.N. Mago—Research Officers, Mahal Singh and Kushal Pal the artist.

Opinions expressed and conclusions reached are my own and do not necessarily reflect the views of the Government.

Before closing, I must express my indebtedness to Dr. M.S. Randhawa, I.C.S. (Retd.) for having spared his valuable time to grace this book with his highly appreciative foreword.

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L.C. Sharma

Foreword

In the hunting and food-gathering stage man lived in the forests and depended upon forest vegetation for his food. When he became an agriculturist, he felled trees for building houses, for fuel and to carve out fields for cultivation. The felling of trees was indiscriminate because it was not realised that it would imbalance the natural eco-system and thus adversely affect the economy. The continuous increase in population brought pressure on land led to an increase in the demand for timber and consequential decrease in the forest area. The pressure on forests has been continuing ceaselessly for a long period but, in recent years the forests have gained more importance than before because they are being utilized as sources of raw material for a large number of manufacturing industries. Timber and wood have come to occupy a place of pride in world economy.

The country needs forests for wood production, amenity and recreation, and nature conservation. Natural forests can serve all the above purposes except cheap wood production needed to feed the industries continuously. Since natural forests are low producers, they are unable to meet the fast growing need of wood in industries. Unlike minerals, timber resources are renewable and are capable of being increased quantitatively and qualitatively with proper care and effort.

As population increases the wherewithall for its sustenance is in continuous demand. Timber has come when with an uncontrolled increase, population will ruin itself because food cannot continue to be produced to meet the demand and the growth in timber resources and population cannot run concurrently. It is, therefore, time for all experts—economists, foresters, demographers, engineers and other scientists—to study this aspect in its proper perspective with a view to suggesting a workable model for harnessing the forest resources for optimal use and also to properly expose the foresters to the Principles of Economics of forest resources. It is interesting to know that compulsions of growing population and increasingly

sophisticated civilization affect the natural forest wealth and that hitherto accepted rate of growth of forest wealth cannot meet the current demand. It is essential on the part of foresters to know the rate of growth of demand for forest resources so that the available scientific knowledge may be fully utilized for increasing the forest wealth. It is essential that the foresters, while tackling the physical aspects of the forests, are made aware of their economic and social aspects. It is in this context that Dr. Sharma's book **FOREST ECONOMICS, PLANNING AND MANAGMENT** is to be viewed. He has brought home the urgency of providing a grounding in and emphasizing the need of economics of forests for the foresters for optimizing the utilization of forest resources.

The author Dr. L.C. Sharma has specialised in the field of Forest Economics and is at present working as a Research Officer in the Planning Commission. He completed a course of instruction in "Economics of Dynamic Plantation (Forestry)" provided by the British Government under the Colombo Plan. In this connection he toured France, Holland, West Germany, Switzerland and Italy. Before joining the Planning Commission, he toured India widely and has written techno-economic surveys in the field of wood-based industries in respect of Punjab, Himachal Pradesh, West Bengal, Kerala, Manipur, Tripura and Karnataka. As such he is well qualified to write on the economics of forest resources of the country. He has brought his wide research, immense training and empirical observation to bear on this most important aspect of forestry now engaging the attention of foresters and economic planners. Dr. Sharma's approach is multi-disciplinary. He has given an exhaustive rendering of economic principles with forests and forestry as work experience. It is in a way teaching-through-experience for students of forestry.

Dr. Sharma gives a historical survey of forests which provides the right perspective for understanding the present conditions of forests. Assuredly for this the author has dug deep into Indian literature. A reader should find this book as a useful source of reference on varied subjects like uses of forest product, production and marketing of wood, wood utilization in various industries, marketing problems, management aspects and the

contribution of forestry sector to the national economy. It deals with economic history of forestry, forest types, their climatic and edaphic distribution. A few international illustrations are both illuminating and refreshing.

The subject that interests most in the context of today's needs of forest produce and the painstaking work in the field of forest research is of man-made forests. Given the minimum extent natural forests to preserve flora and fauna, other demands for forest produce can be related to areas under man-made forests. The planners in a developing country should, therefore, so plan its forests that requisite supplies of wood are available over long periods. Like short maturing varieties of foodgrains, early maturing varieties of industrial wood could perhaps be evolved. The development of natural forests in general and those of man-made in particular needs to be accelerated.

Dr. Sharma has tried to estimate the demand for wood through the end use method. In this process he has collected a lot of information and data which would be useful to the industry as well as to the forest planners. I commend this book to those who wish to have varied information on forests in one volume. It deserves to find a place in the curriculum of institutions meant for training and educating the foresters.

M.S. Randhawa
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3 June, 1979

CHAPTER I

Physical Setting

Introduction

The Republic of India has a land frontier of 1,52,000 km. but its sea coast is only 6,100 km. long. The mainland extends from 8° N to 37° N and from 68° E to 97° E. It measures 214 km. between extreme latitudes and 2,933 km. between extreme longitudes. It is the second most populous and seventh largest country of the world. Its area is 32,87,782 sq. km. and its population in mid-75 was estimated to be 597.9 million.

The Physical and Cultural Background

The Himalaya the 'abode of snow' feeds the northern river system with water which is used to irrigate a large area of arable land. With other mountain ranges of Kashmir, it forms the northern boundary of India. On its west, north and east are Pakistan, Afghanistan, China and Burma. Bangladesh is surrounded by India on three sides. India tapers off to the south into the Indian Ocean, with the Arabian Sea on the west, and the Bay of Bengal on the east. Cape Comorin (Kanya Kumari) the southernmost point of the country is thus the meeting place of three seas—Indian Ocean, Arabian Sea and Bay of Bengal. The Palk strait and the Gulf of Manar separate India from Sri Lanka. Sandwiched between the Deccan plateau and the Northern mountains are the Sutlej-Gangarajmahaputra plains most densely populated and the cradle of culture and civilization on earth.

The Khyber pass, now in Pakistan, facilitated the influx of invaders, adventurers and marauders for a long time in the past. This caused a political turmoil on the one hand, and cultural enrichment on the other. But culture could not undergo much change in comparison with the political upheavals that swept the country from time to time. The Indians were once so sea-faring people as is amply borne out by the Gupta

Period and they enjoyed coastal as well as international sea trade before the advent of the European people in India.

The superimposition of industrialization over tribal economy is of a recent development in the steel belt of Bihar, M.P., Orissa and West Bengal. Likewise, the industrial estates of HAL, ITI, and HMT stand cheek by jowl with the agrarian landscape on the Karnataka plateau. In the same way the Renukoot complex is a little industrial oasis in the tribal economy of Mirzapur district of the U.P. The country holds vast uninhabited tracts in Laddakh, and Thar but carries some of the highest population densities in its river basins, deltas and littorals. But despite all these natural contrasts and changing socio-economic and political patterns, this country holds its single territorial unit on a national scale. The country is in fact a union of diversifying interests—physical, cultural and economic. Climatically, India is a tropical monsoon country but it has many shades of climate ranging from dry continental to humid littorals.

Our cultural ties have withstood the test of Muslim and British rules which failed to disrupt them. Indeed, our political unity will continue to desire its inspiration from our strong cultural basis.

Geology

Geologically the country amalgamates within its territorial jurisdiction landmasses which represent all ages from pre-Cambrian to the recent. The Peninsular massif is the oldest geological formation in India. It functioned as the stage on which several acts of geological drama were played and every act of the drama has left its deep imprint in some form or the other. This massif is the part of Gondwanaland, till it ruptured and drifted sometimes in the mid-mesozoic era (about 200 million years ago) which lay somewhere near South America. The continuous series of islands in the Arabian sea are the relics of the former links. Flat summits, deep valleys, dykes, and folds—all provide evidences of the alternating periods of disturbances and silences which are held responsible for the present configuration of the country. Following are the broad geological phases which have carved out India.

1. The first phase represents the act of cooling and solidification of the upper crust of the earth surface in the pre-Cambrian era (prior to 600 million years). This cooling effect gave rise to the Archaean gneisses and granites especially on the peninsula. Afterwards minor igneous activities, subsequent metamorphism and crumplings alongwith the folding of the Aravali Mountains came into existence.

2. The Dharwarian group (Bijawars), which came into existence by the levelling of the undulations and crushing and crumplings of the sediments, cannotes the second phase. It is characterised by highly metamorphosed rocks of both igneous and sedimentary origin.

3. The calcareous and arenaceous deposits in the Cuddapah and Vindhyan basins denote the main sequence of events, viz. the Cambrian (500 million years ago). Cuddaphas are certainly older (pre-Cambrian and Cambrian) as they underlie the Vindhyan. But there is the controversy in respect of the chronology of upheaval of Vindhyan which stands unresolved as yet.

4. The Permo-Carboniferous glaciation, designated as Gondwanas, are preserved, along with transgression of the Permian (270 million years ago) show the major activities of this phase.

5. This phase can be recognised as world's major event in the form of fracturing and drifting of the continental mass of Gondwanaland (mid-Mesozoic, 200 million years ago). Probably the subsequent uplift of the Vindhyan is on account of this drift.

6. Close to the Mesozoic (70 million years ago) there appeared one of the greatest volcanic eruptions, the Deccan Lava Flows, covering more than 5,00,000 km² areas. This was followed by the first phase of the Tertiary orogeny—the Karakoram phase.

Physiography

India comprises four physiographic divisions — (1) the northern mountains, (2) the Sutlej-Ganga-Brahmaputra plains

of the north, (3) the Deccan plateau, (4) The coastal plains and islands.

The Mountainous Region of the North

This region can be discussed under two heads as follows:—

(a) The trans-Himalaya in the northern part of Kashmir, there are three ranges, the Zaskar, the Laddakh, and the Karakoram whose highest peak is Mt. Godwin Austin or K², 8,611 m. high and which has the longest Baltoro glacier in India. These mountains are very high and snow-covered. The Indus flows south-east—north-west between the Zaskar and Laddakh ranges.

(b) The Himalaya extends between the Indus gorge where it turns south round the Nanga Parbat (8,126 m.) and the Brahmaputra gorge in the east where the river turns south to enter India around Namcha Barua peak (7,755 m.), in three parallel ranges in an arcuate shape, bending southwards. (Some geologists however, hold that Himalaya extends beyond the Indus and the Brahmaputra towards the west and the east respectively.)

The three ranges are:—

(i) The Great Himalaya or Himadri, the northernmost, ranging in height from 5,490 m. to 8,848 m. The Himadri contains some of the highest peaks of the world like the Everest (9,948 m.) and the Kanchenjunga in Sikkim (8,598 m.). This range is perpetually snow-covered.

(ii) The middle Himalaya or Himachal, with heights from 1,830 m. to 5,490 m., consists of ranges like the Pir Panjal, Dhauladhar and Mussoorie range. In the east it becomes very confused. India's hill-stations are situated on this part of the Himalaya. Many rivers also rise here, e.g. the Ganga and the Yamuna. It is covered with snow in winter.

(iii) The Outer Himalaya or the Siwaliks are the lowest part of the system less than 1,830 m. This range consists of the newest deposits which have been derived from the rising Himalaya and hence it represents the most recent phase of the Himalaya orogeny.

According to their regional characteristics, the Himalayan system can also be divided into the following sections:—

- A. Western Himalaya—Kashmir Himalaya and Himachal Himalaya
- B. Central Himalaya—the U.P. Himalaya and the Nepal Himalaya
- C. Eastern Himalaya—the Darjeeling-Bhutan-Assam Himalaya and the Purvachal Himalaya

Beyond the Brahmaputra gorge in the east, the Himalaya turns south and continues in ranges like the Patkai, Naga and Mizo (Lushai). From the middle they turn also westward into Jainta-Khasi and Garo hills. These hill ranges are low and forested thickly.

In between the various ranges of the Himalaya, there are intermontane plateaus, wide valleys and plains, large glaciers, deep gorges, and roaring water-falls, thus presenting a picturesque scenic beauty and looking most awe-inspiring. The Kashmir valley, the plains of Nepal and the Doon valley plains are most noteworthy. It is supposed that the Kashmir valley through which the Jhelum flows was once upon a time a big lake, which has now drained, leaving a few lakes like the Dal and Wular etc.

The Himalaya rises sheer from the Indian plain and have thus very steep slopes in the south while in the north they slope gently. This is on account of the fact that while the Himalaya was being built, stress and strain were exerted from the north, and counteracted by the Aravallis and the northern hill ranges of the Deccan. The Himalaya between the Indus and the Brahmaputra is about 2,400 km. long and is about 500 km. wide in the west (Kashmir) and about 200 km. wide in Arunachal in the east.

A few high altitude passes carry trade routes from India to Tibet. They are Karakoram, Leh, Bara Lacha, Shipki, Niti, Darjeeling and Sadya (from west to east).

Geologically, the Himalaya is of recent origin. It is young fold mountain, exhibiting simple and complex folds.

Indeed the Himalaya has been subjected to very severe crustal deformation as the strata are highly folded, faulted and contorted.

The Great Plains of the North

This region covers about 7,00,000 square km. of area of the country. It has been formed by the Sutlej-Ganga-Brahmaputra river system and is thus made of deep alluvial soil, very fertile and productive. Hence one of the most densely populated parts of the world. The scenery is uniform for the most part and lacks variety, so much so that in a distance of 800 km. from Delhi to Calcutta, there is a drop of only 200 m. After the Himalaya had been formed mountains, a sea called Tethys was left between the newly formed mountains and the Deccan Plateau. It was a big geosyncline, which began to be filled with the silt brought by the rivers of the north and the south. Then this land rose and finally the vast aggradational plain was formed.

At the foothills of the Siwaliks are (a) a 10-15 km. wide piedmont plains of gravel and called Bhabar. Many small rivers flow underground in this region and emerge in Terai another tract 15-30 km. wide below Bhabar. The terai is a marshy tract.

Newer alluvium is called Khadar and older one Bhangar. In the latter region sometimes kankar areas are found. Sometimes reh or alkaline deposits are formed in the fields as a result of increased irrigation. The Chambal and the Yamuna have eroded large tracts into badlands on the borders of U.P., M.P., and Rajasthan.

The plains of Punjab, Haryana and West Rajasthan are uplands while the rest of the plain is lowland. Rajasthan presents a dry and arid outlook with sand dunes, barchans, and hills of ancient rocks here and there. The area between the Yamuna and the Sutlej is the watershed of the north Indian plain. In it flows the Ghaggar, now only a rainy season river which gets lost in the sands of Rajasthan. Bihar, Bengal and the Delta area of the Ganga are flood plains. Rivers Ghaghra (Sarju) and Brahmaputra carry more sand than silt. As a result, their beds have been raised and they have built natural levees. But

often these embankments break during the rainy season and the result is heavy floods, causing damage to life and property.

The Deccan Plateau

This plateau covers a large part of the country. It is tilted eastward and is dissected by large rivers like the Mahanadi, Godavari, Krishna and Kaveri flowing east and the Nerbada and Tapi flowing west. Its area is 1.6 million square km. The topography of the Deccan includes high and low hill ranges running in various directions, table-land, spurs and plains made by the rivers. Geologically this is the most stable region of India. It is believed that when Gondwanaland broke up as the peninsula rumbled northwards, faulting occurred in the western side. As a result of it the Western Ghats are steep on the western side and slope gently on the eastern side. Also the plateau got tilted.

In the north-west the Aravallis are the oldest fold mountains. They begin from Delhi where they are very low but they gradually rise in the south and are the highest in Abu area (Gursikhar peak 1,722 m. high). In the north from west to east run the Vindhya, Kaimur, and Raj Mahal hills in Chhota Nagpur plateau (in M.P. and Bihar). To the south of these are the Satpura, highest peak Pachmarhi 1,350 m. Mahadeo, and Maikala ranges ending in the highest peak Amarkantak (1,127 m.). Further south are the Satmala, Ajanta or Sahyadri Parvat. In between are the rivers Nerbada and Tapi. The Nerbada flows in a rift valley flanked by the Vindhya in the north and the Satpuras in the south. The Vindhya form the watershed between the rivers flowing north to Yamuna and those flowing over the Deccan plateau. Generally the height of these ranges varies between 460 m. and 1,220 m. There are other finger-like ranges and spurs projecting eastwards from the Western Ghats south of the above ranges.

The Western Ghat mountain or Sahyadri, forms the western edge of the Deccan Plateau. It is above 1,067 m. high, but in places rises to 2,440 m. It slopes steeply towards the Arabian Sea but gently towards the east. Two passes, the Thal and Bhor carry routes to north and south-east from Bombay.

They are called Ghats because they have ghat-like (landing stairs) formation. The Eastern Ghat mountains are lower in heights—about 610 m. and broken by the rivers flowing east over the plateau. Its various sections are known by different names like Nallamali Range in Andhra Pradesh, Javadi hills and Shevaroy hills in Tamil Nadu. Their highest peak is Mahendragiri 1,500 m. in Orissa. Both the Western and Eastern Ghats meet in the Nilgiri hills, whose highest peak is mount Dodabeta, 2,670 m. in Tamil Nadu. Then comes the Pal Ghat gap, 24 km. wide which carries communication lines between the east and west in South India. Beyond are the Anamalai hills, Palni hills and Cardamom hills, projecting right to the south.

Between the Ghats and the sea are the coastal plains, western one is narrower, about 32 to 80 km. wide while the eastern plain is wider, about 160 km. Both the plains are alluvial and fertile. The large rivers Mahanadi and others have formed wide plains in their basins. Around the Gulf of Cambay the western coastal plain is also very wide but it is drier.

The Coast and Islands

The eastern coastal plain is much wider but has a narrower continental shelf than the western coastal plain. Along the eastern coast, the Mahanadi delta has a smooth outline and is fringed with sand dunes caused by strong wave action. South of it lake Chilka makes the baff coast. Near Vashakhapatnam the Eastern Ghats come very close to the coast. Like the Mahanadi, the Godavari and the Krishna also make deltas and have thus caused a seaward bulge in the coast. North of Madras, lake Pulicut again makes a half coast. In the gulf of Manar in the south there are a few coral islands which are very small. The east coast has not of late (geologically speaking), undergone upheavals. However, in the north there are signs of emergence while near Madras those of submergence, e.g. a lignite bed occurs 70 m. deep under the sea. There lie of the western coast has a greater variety than the eastern. In the north the landscape is arid in the absence of rainfall. The Rann gets flooded with sea water during the rainy season. Loess deposits and salt marshes can be seen along the coast of Gujarat.

Of the Konkan coast Bombay and Goa have excellent natural harbours. Small hills intersperse the coast. Further south, the Malabar coast is more wide and open. The numerous lagoons and spits in the Kerala coast indicate emergence, while the presence of forest at the bottom of sea near Bombay show that the coast has been submerged.

The two groups of islands—the Arabian Sea Islands and the Bay Islands—are quite different from each other in origin and physical characteristics. The Arabian Sea Islands (Lakshadweep, numbering 25), are the main feature of the old landmass and subsequent coral formations. The basin which separates the group from the main landmass is less than 3,000 m. deep.

The Bay Islands lie about 220 km. away from the nearest point on the main land of Burma. They represent surfaces of the Tertiary fold axis which rises as high as 750 m. (Saddle peak) above sea level. The channel which separates them from the main land of Burma is less than 500 m. deep. The total number of Islands is greater than 300. They are separated from one another by narrow creeks. There are deep indents in the coastline which provide favourable harbours. These are the marks submergence of the coast. The North Andaman Islands are physically characterised by a central range and sheltered narrow valleys. The little Andaman almost has a flat surface except the northern hilly tract. The Nicobars are hilly and irregular in form. The islands are characterised by sharply rising hills and narrow valleys. The surface is usually cut by streams which originate in the hills.

Climate

Location and physiographic factors influence the climate of a country. The Tropic of Cancer passes through the middle of the Indian subcontinent so that the southern part is tropical but because the Himalaya prevent the cold polar winds from entering the northern plain, the whole country may be termed as tropical. The presence of the Arabian sea in the west and Bay of Bengal in the east is conducive to rainfall. In summer the whole country is hot, the temperature everywhere being 90° and over. The desert part of west Rajasthan is even hotter. A low pressure centre develops over north western India. The

first four months March to June are very hot and dry. There is little rain at this time. A local hot wind called "Loo" blows from Rajasthan over the north and north-western part of the country. It is a dry and dessicating wind. Then the monsoon breaks in south in mid-June and in north in July. Besides the high temperature and consequently low pressure on land, the other cause the rainfall in India, is the northward migration of the inter-tropical convergence (ITC). The rain-bearing winds start blowing from the sea, where there is high pressure comparatively, to the land where low pressure has developed on account of heat. They come from the Bay of Bengal and from the Arabian Sea. The rainy season lasts for four months. We shall now consider the two monsoon branches separately.

The Arabian Sea Branch of the Monsoon blows in a south-westerly direction. The winds strike the Western Ghat mountains and cause heavy rainfall on the western coastal region. Bombay receiving 193 cms. and further south 254 cms. and over. But Gujarat receives only 51 cms. because of the low Gir hills. However, the winds find a passage through the valleys of Narbada and Tapti to reach inland in the north of Deccan and places like Nagpur get about 127 cms. of rain.

After crossing the Western Ghats the monsoon winds are devoid of much of their moisture. Besides, they descend over the plateau and get compressed so that they retain the little moisture they still carry. Thus the eastern part of South India is in the rain-shadow and has a poor rain-fall, about 64 cms. There is a little more on the eastern side because of the Eastern Ghat mountains.

The Bay of Bengal Branch of the Monsoon blows over the Bay of Bengal in a south-westerly direction, first striking the mountains of Burma, then turning north, providing Bengal, Bangladesh, and Eastern India with a heavy rainfall because of the Assam hills and the Himalayan mountains being close. Then again they turn west, guided by the Himalayan mountains. But as the winds proceed westwards, they naturally get drier because they lose their moisture on the way. Thus Calcutta has 163 cms. Patna 127 cms. Allahabad 102 cms. and Delhi

63 cms. and near Amritsar it is only 38 cms. The lower Himalayan regions get more rainfall because the clouds condense by coming in contact with the high mountains. Thus Darjeeling has 241 cms. Simla 178 cms. Dharamsala and Delhousie over 254 cms.

The central Indian plateau besides attracting the Arabian sea branch, gets rain also from the Bay of Bengal and thus it has ample rainfall. But Rajasthan is a dry area. The Arabian sea branch of monsoons meets no mountains east-west here and so no condensation can take place to cause rainfall. The Bay of Bengal branch comes across the Aravallis east-west but by the time they reach Rajasthan, they are dry winds and very little moisture is left in them.

In winter there is a high pressure belt over the land and the sea has comparatively low pressure. As a result winds now blow for four months from November to February from land to sea. They are dry winds and cause no rain except on Madras coast where they reach after they have picked up moisture from the Bay of Bengal. Thus Madras coast receives rainfall in both the seasons from both the monsoons, about 63 cms. each time.

At this time the southern part of India is very warm in the north and hot in the south, the temperatures varying between 75° and 85° F. In north India, however, it is cooler at this time because this region is outside the tropics, and the temperature range is 60° to 65° F. There is snowfall on the Himalaya and a cold wave occurs sometimes in the Ganga plain.

In winter a very weak branch of the westerlies reaches Pakistan as a dry wind. But it picks up moisture from the snows of the mountain Hindu Kush and causes rain in Pakistan and N.W. India. This rain is only 25-38 cms. but it is a great boon to the wheat crop that grows at this time.

Thus India has a long summer for 8 months, hot and dry for the first four months and hot and wet for the next four. The last four months have cool winter in north but the south is still warm to hot. In the northern part winter too it is cold only for a month or so, otherwise the season remains mild. The summer is so long because the temperature starts rising

much⁷ before the vernal equinox. This effect cuts short the winter season by nearly a month. In the same way the retarded terrestrial radiation pushes its commencement by nearly a month from the autumnal equinox. The act reduces the duration of winter to about four months and thus the summer is very long.

Soils

The development of Indian soils has taken place under hot and humid climate. The large scale variations occur owing to the tints, chemical composition, texture, structure, reaction and plant food contents. The human populace is one of the factors responsible for converting even poor quality land around it into richer with respect to humus, texture etc. For the convenience of description of soils, these have been divided into six categories as follows:—

- A. Alluvial Soils
- B. Lava Soils (Black Soils)
- C. Soils of the Archaean and Cambrian Rocks
- D. Mountain Soils
- E. Sandy Desert Soils
- F. Coastal Soils

A. Alluvial Soils: Such soils are found in the Great Plains and in the deltas of the rivers and also the river valleys. These soils are generally one foot deep. These soils can again be divided into two, i.e. (1) Alluvial loam and (2) Calcareous clayey alluvial.

(1) Alluvial loam, and (2) Calcareous clayey Alluvial Soils: The first is low-lying relatively younger, flood plain alluvium called Khadar. The second consists of the older alluvium called Bhangar. The fertility in the former gets revived on account of annual silting while the latter is prone to more leaching. Recurring application of doses of fertilizer saves the fertility in the latter case. The Bhangar is well suited for the cultivation of rice while Khadar lands are suitable for growing other crops. Khadar soils are usually richer in humus but generally produce one crop as they remain over-flooded during monsoon.

B. Lava Soils (Black Soils): Black soils are locally called 'regur'. They have developed over the lava deposits by the weathering of the trap in most part of Maharashtra, western Madhya Pradesh, Gujarat and the adjoining parts of Andhra Pradesh and Karnataka. These soils are alkaline in reaction. The Kaveri valley has an isolated enclave of such soils. These soils are moisture resisting but they develop cracks in summer. They are deficient in nitrogen, phosphoric acid and organic matter but they do not lack in lime contents.

C. Soils of the Archaean and Cambrian Rocks: These soils belong to the omnibus group. They have developed over Archaean granite, gneiss and other crystalline rocks. They are combination of the sedimentaries of the Cuddapah and Vindhyan basins and the mixed Dharwarian group. These soils are sandy to loam in texture. On the fringes they get integrated with bordering soil groups.

D. Mountain Soils: The Himalayan soils are a combination of deep alluvium in the valleys to highly immature gravelly soils. These are having variations in altitude and vegetation. There is no deep study on these soils so far but their vegetation cover works as guide to their classification.

E. Sandy Desert Soils: Such soils appear in parts of Rajasthan, Saurashtra and Kutch. Their development has taken place under arid and semiarid weathering. These soils are sandy to gravelly with low organic matter, low nitrogen etc. Saline soils occur in patches.

F. Coastal Soils: These soils differ in texture and structure. The East Coast has riverine soils in the delta regions. Marshy tracts are local variations especially in deltas and inter-deltaic regions etc.

Floristic Composition:

The structure and appearance of a forest type depends on the local floristic composition to some extent. The flora of India differs considerably in various parts of the country both in specific identity and in number of species. There are some species which are found throughout the country while others

are localised to some small areas. The following are floristically recognised regions in India:

1. Western Himalayan
2. Eastern Himalayan
3. Sutlej Plain
4. Gangetic Plain
5. Central India
6. West Coast (Malabar)
7. Deccan Plateau
8. North-East India (Assam) and.
9. Andamans and Lakshadweep Islands

The Western and Eastern Himalayan flora differs in as much as the coniferous species occur in a greater degree in the latter. While the former contains more of European element, Malayan, Chinese and Burmese elements are predominant in the latter. North African components influence the flora in the Sutlej plain. Major species are a common factor in all the regions.

Forest Types of India

The following types of forest are recognised in India at present:

I. Moist Tropical Forests

- Group* 1. Tropical Wet Evergreen Forests
- Group* 2. Tropical Semi-Evergreen Forests
- Group* 3. Tropical Moist Deciduous Forests
- Group* 4. Littoral and Swamp Forests.

II. Dry Tropical Forests

- Group* 5. Tropical Dry Deciduous Forests
- Group* 6. Tropical Thorn Forests
- Group* 7. Tropical Evergreen Forests

III. Montane Sub-Tropical Forests

- Group* 8. Sub-tropical Broadleaf Hill Forests
- Group* 9. Sub-tropical Pine Forests
- Group* 10. Sub-tropical Dry Evergreen Forests

IV. Montane Temperate Forests

Group 11. Montane Wet Temperate Forests

Group 12. Himalayan Moist Temperate Forests

Group 13. Himalayan Dry Temperate Forests

V. Sub-Alpine Forests

Group 14. Sub-Alpine Forests

VI. Alpine Scrub

Group 15. Moist Alpine Scrub

Group 16. Dry Alpine Scrub.

I. Moist Tropical Forests

Group 1. Tropical Wet Evergreen Forests: This type of forests are found throughout the tropical extent of the country. These flourish wherever the rainfall is adequate and well distributed throughout the year except on those slopes where the precipitation is heavy and run off is rapid. They happen extensively along the Western Ghats from Tirunelveli leading upto Bombay. Often residual patches are found especially towards the north. These forests are also found along the whole length of the Western Ghats through Karnataka (Shimoga, Mangalore, Coorg, Wynaad), Palaghat, Tirunelveli. Such forest do occur on moist loamy hills throughout the Andaman Islands.

These forests are usually lofty, dense, evergreen. They often grow to 45 metres high or even more. There are large number of species of trees which occur together. The trees are usually gregarious dominants. Some species of the top storey are trees which have clear boles 30 metres long and 5 metres or more in girth. The trees are briefly deciduous with evergreen forest as a whole. The canopy is extremely dense. Climbers vary greatly in amount. Ground vegetation is usually absent. The undergrowth represents canes, creepers, bamboos and palms. Erect and tall bamboos are unusual, but may occur sometimes. These forests are full of cylindrical boles with thin smooth bark. The leaves are thick and glossy.

Group 2. Tropical Semi-Evergreen Forests: This type of forests occur throughout the moister parts of southern tropics always in association with the true evergreen. They do not

occupy a very large area as there are but few extensive tracts. These forests are particularly marked in the Western Ghats where the rainfall is very steep.

It is very difficult to define such forests as they are quite variable in character. The dominant large trees usually having inferior wood occur gregariously in these forests. There are many species in these forests but the large sized evergreen trees are absent there. Buttressed stems are frequently seen. The general canopy is typically less dense than in the true evergreen. Climbers are usually very heavy. Bamboos are often present there but they are less prevalent than in the moist deciduous.

Group 3. Tropical Moist Deciduous Forests: This type is met with throughout the Andaman Islands covering about half of their total area. Similar forest area is limited in the Nicobars.

There is typically a somewhat irregular top storey of predominantly deciduous trees about 40 metres high or more. There are many trees having large girth but they are heavily buttressed. They are followed by a rather definite second storey, which comprises many species including some evergreens, though most of them are deciduous. There occurs a fairly complete shrubby evergreen undergrowth, including patches of bamboo. Climbers—canes are usually very heavy.

Group. 4. Littoral and Swamp Forests: These forests are found all round the coast where there is a fair width of sandy beach including sandy bars occurring on the sea face of the river deltas.

These forests are dominated by tall evergreen species. They include very light foliated casuarina which often forms an almost pure fringe on sandy beaches and dunes along the sea. *Manikara littoralis* replaces casuarina in Andamans. There are scattered smaller evergreen trees with fewer deciduous trees. They form the dominant canopy in the absence of casuarina. There are shrubs there. Maritime grasses and surface creepers are mainly seen there to bind the sand. The tidal species are poorly developed in the depressions which are often swampy with saline water. They have a dense undergrowth.

II. Dry Tropical Forests

Group 5. Tropical Dry Deciduous Forests: This type is found throughout the Indian peninsula, except Western Ghats where the rainfall is as high as 1,900 mm. These forests have a tendency to merge into thorn forest in those areas which receive rainfall less than 750 mm. They occur like this in the large tract to the lee of the Western Ghats. These are found in Madhya Pradesh, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.

The upper canopy in this type is a closed one but uneven and thin. A mixture of trees usually deciduous forms this type. Most of the species occur in the moist deciduous forest where they develop well. The height of the dry deciduous forest usually varies from 13 to 20 m. The number of species is much less than anywhere else. They are usually single species crops outside the sal forest in India. The lower canopy is completely deciduous though evergreen and sub-evergreen are also visible. They are found mainly confined to the moister and more sheltered spots. The undergrowth comprises shrubs. Enough light passes through the canopy which does not allow grass to grow there. Bamboos are often present there but they are not luxuriant. Canes and palms are absent. There are few climbers but large woody species are found there.

Group 6. Tropical Thorn Forests: This type is found in the Central India throughout the dry peninsular tract to the lee of the Western Ghats from extreme south right up to Indore and Bhopal. This is thus important in Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.

They are open low thorny forest where hardwood species are prominent. The main species are Acacia. The trees have short boles and consequently low branches crowns which often do not meet. They are usually 6 to 9 m. high. A few species are found in mixture. The lower storey is all ill-defined. There are small trees with large shrubs mostly spiny. A thin grass growth occurs there. This growth appears to be complete during the short lived rainy period. Few climbers are seen there.

Group 7. Tropical Dry Evergreen Forest -This type is visible restrictedly to the Karnataka coast under unusual climatic conditions which prevail there. It is found on the east coast starting from Tirunelveli northwards to Nellore. Such forests do appear in large areas in Sri Lanka. These forests are better developed there than in India.

These forests are regarded as low from 9 m to 12 m. high. They form a complete canopy comprising mostly small coriaceous leaved evergreen trees. They have short boles and spreading crowns. There are a few species there but having a marked mixed species. Pure consociations is an exception there. Numerous types of climbers are found there. Bamboos are found rarely there. The grass is not conspicuous in this region though it is present there. Felling, lopping and browsing have a great influence on the forests which have made them irregular with open patches here and there. The thorny and unpalatable species have largely disappeared from the scene.

III. Montane Sub-Tropical Forests

Group 8. Sub-Tropical Broadleaf Hill Forests : Sub-tropical forests are visible within a zone from about 1,000 m. to 1,700 m. on the higher hills in South India. Such forests are also found on hills above 1,000 m. on the higher hills in Central India including outliers such as Mt. Abu (1,360 m.).

These forests exist in two different forms. One distinctive form occurs in a well-distributed fairly high rainfall which appears on high hills in the south. The adjoining forests in this part are tropical forests of wet evergreen type. The second form is found under a lower unequally distributed rainfall having a marked dry season. Their adjoining forests are of tropical dry deciduous type. Such conditions prevail on more isolated hills of the central part of the country.

Group 9. Sub-Tropical Pine Forests : Forests of *Pinus roxburghii* are found occurring between 1,000 m. and 1,800 m. extending on ridges down to 600 m., and rising up to 2,300 m. on southern exposure. They extend throughout the whole length of the Western and Central Himalaya from the N.W. Frontiers to Sikkim and West Bhutan.

Forests of *pinus insularis* (*Pinus khasya*) occur at similar heights in the Khasi, Naga and Manipur hills.

These forests are typically found in pure stand of pine (*roxburghii*). They are generally influenced by the annual or periodic fires which take place now and then. The top canopy consists of pure stand. Practically there is no under-wood occurring there. Shrubs are found in small quantities. Broad-leaf species are found as understorey where moisture conditions are little more favourable. These trees are mostly evergreen oaks, and increase with rising altitude. Thus leaving the pine on the warmer, drier ridges. There is a corresponding increase of the trees of dry deciduous type towards the lower limit. A number of bulbous and annual herbs occur there with a grass soil cover. They flower in the rainy season. Climber and bamboos are totally absent there.

Group 10. Sub-Tropical Dry Evergreen Forest : The extent of such forests is very small.

IV. Montane Wet Temperate Forests

Group 11. Montane Wet Temperate Forests: This type is found on the higher hills of Tamil Nadu and Kerala on the Nilgiris, Anamalai, Palni and Tirunelveli hills from about 1,500 m upwards. Such forests are found in the higher parts of Sri Lanka also.

This is a closed evergreen forest. The trees have mostly short boles with many branches. Trees in these forests usually attain a considerable girth. The forests have relatively low height, rarely exceeding 6 m. The trees have dense crowns with round shape. The leaves tend to be red to a varying degree when young. Thus they produce a range of colours. Woody climbers are common there. The branches are clothed with mosses, ferns etc. There is a continuous series of shrubs and under shrubs to the large trees. The forests exist in patches (sholas) in the more sheltered sites

Group 12. Himalayan Moist Temperate Forests: This type forms an extensive area along the whole length of the Himalaya between the sub-tropical pine forests and the sub-

alpine forests. These forests occur with a rainfall ranging from 1,000 and about 2,500 mm. These forests are found in Kashmir, Himachal Pradesh, Punjab, Uttar Pradesh, Nepal, Darjeeling district of Bengal, Sikkim and Bhutan. The altitude should vary from about 1,500 m to 3,300 m.

These forests are characterised to be the extensive development of conifers. These conifers have great similarity with those forests which occur in other parts of the North temperate zone in Europe and America. The dominant species are few and these are found in pure stands. The species which are found there, mainly depend on altitude and aspect. The ever-green oaks are found in admixture and become increasingly important towards east. The conifers often form open forest of good height, viz. 30 to 50 metres or more. In the south the conifers are replaced by oaks. Climbers of temperate genera like *Rosa*, *Clematis*, *Hedera* are frequently found but they are unimportant. The whole area of this forest type is subject to heavy grazing mainly by sheep and goats. Lopping of the trees is a common feature in this type.

Group 13. Himalayan Dry Temperate Forests: This type is found in the inner ranges of the Himalaya which experiences the feeble S.W. summer monsoon and the precipitation is under 1,000 mm mainly owing to snow in winter month. These forests occur in Kailash (Laddakh), Lahaul, Bushahr, inner Garhwal, Sikkim and Arunachal Pradesh also.

These forests have an open formation with locally closed canopy only. These forests usually have coniferous species. The broadleaf trees which occur there are poorer in height, growth etc. Their occurrence is scattered among the conifers. They sometimes form more or less pure patches.

V. Sub-Alpine Forests

Group 14. Sub-Alpine Forests: This type occurs in the Himalaya adjoining Alpine scrub or grassland. These are found in strips along with spurs between snow-slides, on sheltered slopes and over favourable spots. These forests are seen from Kashmir to the eastern parts of Arunachal Pradesh where they appear to be most extensively developed. This type finds its way into the dry zone of N.W. India but not into W. Tibet.

These forests are dense in growth with small crooked trees. They have large shrubs with patches of conifers overwood. The existing conifers are abies which have low branches and densely habitated. The blue pine which occurs side by side differs from the low level form in its shorter and denser foliage. The birch which is typically present there is the only broadleaf tree with a fairly clean tall bole. The rest have crooked branchy stems. These stems are often bent at the base owing to the pressure of snow. The forests are evergreen. Rhododendron the broadleaf tree is the most common constituent in these forests. Pure Rhododendron forest 3 to 10 m high covers large areas in Sikkim and the N.E. The conifers rarely reach 30 m except in sheltered spots. The broadleaf woods are often about 6 to 10 m high.

VI. Alpine Scrub

Group 15. Moist Alpine Scrub: This type is found along the whole length of the Himalaya and on the highest hills near the Burma border.

This type forms a low evergreen forest having broadleaf species usually Rhododendron. The forests are so dense that it is difficult to penetrate in them, particularly in an uphill direction. The trunks of the trees are short and branchy. These are not usually over 60 cm in girth. The birch above the firs make a pure stand.

Group 16. Dry Alpine Scrub: This type is widespread in the inner ranges as in W. Tibet behind Kumaon extending into India in Uttar Pradesh, Himachal Pradesh, the Punjab and Kashmir. This type adjoins the dry temperate forests and may take their place under heavy pressure of grazing etc.

CHAPTER 2

Forestry and Economic Relationship

Forestry can be viewed in relation to other social sciences also. The political science of forestry is the "Forest Policy". The Sociology of forestry is usually included in the economics of forestry, as very little is as yet known about it.

This book deals with the economic relationship between man and forests.

Economics

Economics is defined as the study of man's action to secure material means of satisfying his wants. The means to satisfy his wants are scarce. If means were unlimited, no problem would have arisen at all. Even if the means are scarce, but there is only a single end, the case of how to use the means is technological problem. Therefore, no value judgements enter into its solution; but the knowledge of physical and technical relationships. For example, suppose given amounts of wood, labour etc. are available to construct a building. This is purely a technical problem which requires the knowledge of engineer and of physical science. Alternatively, let the objective be to construct the "best" building, where the concept of "best" involves not only the size of the building but its utility, beauty and all other allied factors. This involves multipurpose uses and not the single end. This becomes economic problem, involving value judgements. Economics does not study a single individual but it studies the economic problems of a people living in a society. There are innumerable problems which we have to face at every step in life. How are we to single out the economic problems? Do economic problems have special features? The economic problems have two main characteristics. First they arise because we feel wants which include both ordinary physiological wants and the refined desires as well.

The refined desires are consequential to our living in the complex civilisation of to-day. Economic problems are concerned with the satisfaction of these wants. Another important aspect of economic problems is that they arise from the fact that the things or the resources in men, materials or time, which do satisfy our wants are limited or scarce. The word scarcity conveys a special sense here. If supply of a certain commodity is insufficient to satisfy the aggregate demand for it, it becomes scarce. Thus the scarcity of human resources compels people to take up various activities. Economic problems are those which centre round such activities. For example, the water is an essential commodity to fulfil human needs. The water at the bank of a river is not scarce on account of its availability in plenty, but the same becomes scarce in case of a city dweller. In the city water supply becomes scarce in relation to the huge demand created by the existence of large population. Therefore, the problem of satisfying this want for water becomes an economic one. Economics is, therefore, a study of "man's actions which make the satisfaction of wants possible". Some economists consider this definition to be very narrow. This difficulty arises when we find that human behaviour and activities cannot be kept in water-tight compartments of "economics", "sociology" and "ethics" etc. Human actions control primarily economic considerations but political, social and ethical considerations influence economic decisions. Anyhow, a study of human behaviour in relation purely to economic grounds will prove useful.

Economics deals with goods and services; lumber, grains, picnic grounds and railways rendering services etc. Economics is mainly a study of the economics of production. It concerns how people grow corn, and manufacture furniture, construct buildings etc. Once production comes into being it concerns with its distribution, viz. how the apples of Himachal Pradesh sell in Delhi or Bombay and how the salai wood of Madhya Pradesh is converted into newsprint in Nepa Mills. Further, economics concerns itself with consumption, for example, how man decides to manufacture furniture to be used in the homes and offices or the doors and windows for the building; the act of use being consumption. This forms the subject matter of

economics, but over and above this, there is something else—utility—a common thread to bind all these activities together.

Utility is the ability of a particular item to satisfy a human want or desire. The item may be directly consumed or may help indirectly the production of other goods and services. In addition to utility, one item must be scarce to become an economic resource. For example, water in a river is not that scarce and utility bearing as it is when it reaches a city water supply scheme.

Since economic resources are scarce and the human wants are unlimited, man is forced to economise in their use. One cannot satisfy all one's wants. Then there are alternative uses of most goods and services. A tract of land may be put either to growing sugarcane or wheat. The decision as to what use it is put to is an economic one.

Broadly speaking, there are two types of economic choices. (1) how should the existing resources be allocated to different possible uses to satisfy the largest number of wants? Should a given land be utilised for growing cotton or eucalyptus trees? If the choice falls on growing trees, should the wood be consumed for manufacturing charcoal or for pulp to be used for manufacturing paper? (2) How the goods and services which are produced with these economic resources be distributed among their possible consumers? In fact it pertains to the problem of distribution, viz. actually dividing the fruit of production among all those who are desirous of having them. Growing of timber needs the services of wood labourers and landowners, bankers, foresters etc. The economic problems of forestry are primarily those of right allocation of scarce resources for optimal production.

Forestry

Forestry has been defined by so many associations in the world. The Government of India¹ defined it comprehensively as "the theory and practice of all that constitutes the creation,

¹Government of India 1970. Indian Forest and Forest Products Terminology *Indian Forest Records* (New Series) Silviculture. 10 (6). Manager Publications Delhi. pp. 215

conservation and scientific management of forests and the utilisation of their resources". The definition provided by the Society of American Foresters is as "the scientific management of forests for the continuous production of goods and services". This definition is somewhat too restricted for the purpose of this book. But forestry exists ultimately for the satisfaction of the consumer's wants, if the economics of forest management must clearly corroborate the theme of economics. The management of forests includes harvesting and processing of forest crops. Forestry is a kind of human productive activity. Production of forests is possible through the help of the primary economic resources, viz. forest land and growing stock. Though nature produces wood and other forest products without the help of man, such crops may not fulfil the requirements of man. The forest land — and economic resource, it being scarce — may produce woody and stunted tree crop. Even if there grows a good forest crop, it may be less suitable for wood production under modern conditions as the industries need a perpetual supply of raw material at low cost. The man comes forward to grow man-made plantations nearly homogeneous in quality according to his desire. For this purpose he requires other factors of production—labour, capital and management ability —which might otherwise be used for some other purposes.

Forestry faces mainly three types of economic problems. The first one is concerning the total amount of productive resources available for forestry production. These are usually decided by the factors which are beyond the control of the foresters. Most important among them is the growth of overall productive capacity of the economy and the size of the national income. The distribution of national income among wages, dividends, taxes, profits etc. largely decides what kind of goods and services should be produced in an economy. The government takes these decisions keeping in view the prosperity of the people and the national security. Finally there lies the choice by consumers—both private and public —between the individual goods and services which can be produced by forestry. These goods combined with all the other goods and services which the rest of the economy produces, makes a total demand for the various forestry goods and services.

The second type of problem in forestry arises on account of allocation of resources which are required for production of different goods and services. The demand for these products is closely related to this type of activity. This gives rise to the phrase "consumers are willing to buy certain quantities at certain prices". This choice decides the demand for a particular commodity.

The third type of problem is the efficiency to which economic resources can be subjected in the production of forestry. This is the concept of minimum cost problem. In other words, it is: how can a minimum amount of economic resource be employed to produce the maximum amount of goods and services? The solution of the third problem is tied up with the solution of the second one. For resources are difficult to be allocated satisfactorily in the absence of an efficient method of production.

The Forestry Economics

Truly speaking, we have been discussing of the economics of forestry since the very beginning of this chapter. The principles and theories of economics apply to forestry just as they do to any other human behaviour. This attracts our attention towards "economics of forestry" rather than towards "forest economics". The economics of forestry centres round the question of resource management in respect of forests. It would be better to call forest land management as the hub of the wheel of economics of forestry while the management of forest products, conservation, distribution, and consumption may be regarded as its spokes. The subject matter of economics is man with a study of certain aspects of his own behaviour. This is said to be his behaviour, "in the ordinary business of life¹. If this study of human behaviour is applied to forest resources, man directly is attached to the field of economics of forestry. But if it is so, why do we need its study as a separate subject? The answer lies in the fact that forestry possesses some characteristics which distinguish it from the remaining economy. First is the prolonged gestation period which is the

¹Marshall, Alfred: principles of Economics, 8th Ed., Macmillan and Co., Ltd, London, 1930, P.1.

most outstanding feature of forestry. The production of timber involves a long gestation. Secondly the forest consists of a producing capital and at the same time it has the character of a store-house. Much timber is, at one and the same time, both capital plant and finished product. Thirdly, many forest values are not measured directly by existing markets. Fourthly, forestry is in a high degree an industry which is tied to nature. Fifthly, the classical economists considered land including forests, as a fixed factor of production. Land is said to be a God-given gift but the supply of forests is not restricted. These can be either afforested or deforested at the will of man. Sixthly, forestry, like agriculture, fisheries etc., depends on growing products rather than manufacturing them. Seventhly, wood is a matter which grows on existing trees. Finally, forestry produces not wood alone but also other products and services such as recreation and water which may be reckoned as joint products. In such a situation their valuation is difficult. Over and above, according to Dr. Vaux, a special study will still be necessary even if the above characteristics are absent. It is because forestry has some special peculiarities in respect of its organisation, institutions, techniques, and terminology. Secondly the human activity in the world has become very complex and the total knowledge has spread vastly so that neither can a person know nor he be interested in everything. This is true of Economics also. All these factors assume particular economic significance in respect of forestry which makes it a part and parcel for a special study.

Human Economy in Society

There is a high degree of correlation between society and economy. Society comprises a group of people whose lives are interrelated to each other in some way or the other. Family ties are often the strong binding threads for these groups. Geographical situations also work as binding threads. Then political strings bind men and nations. Similar is the role of culture. The concept of society is quite flexible. There can be different kinds of societies. One society can exist within another or overlap it.

Economy denotes the economic aspect of a society's environment and activity. The economy of a society hinges on

the existence of people, agricultural fields, forests, factories, consumable goods, etc. In fact everything worth naming having economic value constitutes a part of the economy. But one thing is very clear that the economy has no material value exclusive of its own. For example, a patch of forest land which forms a part of the economy has its identity as geographic, political, engineering and artistic. Economy is just as good a viewpoint as economics. The character of our economy is abstract. Goods and services come into consumer's hands through this character in our economy. This is done more or less in response to the consumers' wants. Natural, cultural and human resources are utilised to fulfil our economic wants. These resources, scarce in relation to the innumerable wants, they have to satisfy, are trusted as the agents of production. Thus the ideal economy is that in which these scarce resources are used to optimise human satisfaction.

Man plays a key role in human economy which he virtually dominates. The economy works on two phases (1) man as a consumer, is the creator of wants and (2) man is also the producer of resources, viz. agent of production—satisfier of human wants. Every human being performs these two important functions. One of them helps us to exchange our money into goods and services created by other people and the other compels us to pass on the goods and services that we have helped create. Thus the goods and services flow through the economy in one direction while the money in corresponding amounts swells the coffers of the people in the other direction.

Aspects of the Economy

The economy of a country possesses several aspects as follows: In the first place it has the material aspect. It deals with things—natural resources, instruments of production, goods in process, and finished commodities. Such things are timber on the sea coast of Port Blair, the logging equipment, railroad, and sawmills; the ship to carry the lumber to the other markets; the warehouse to store this timber, etc. But though we call them economy, they are not so in the real sense. The economy is in one sense far more than that, and yet in another far less.

In the second place the economy is concerned with human aspects—the people. It is worked by the people for themselves.

They are really the ones to control and use the material things—the timber owners and managers, the loggers and millers, the seamen, wholesale traders, builders, and home owners and also their counterparts in other industries. Their labour is either intellectual or manual, and they consume. One might conclude that they are the economy, which is more sound a conclusion than identifying materials with the economy.

In the third place the economy has its geographic aspects. Its materials, persons and events occur at a certain place. The economy of Port Blair can be viewed with a special angle. Peculiarity is attached to its resources, wants and external influences. The geographic relationship of two places becomes important. The study of economics of forestry will reveal and emphasize the importance of place, distance, terrain, and other geographic circumstances in their influence upon the role of forests in economic life.

In the fourth place there is the time aspect. Every economic event happens at a certain time. The dominant characteristics of economics—change and function—are revealed with the passage of time. The time element is further essential in measuring economic activity. This activity is known as flow. With a train, it may be counted as so many kilometers per hour, while with an economy it may be so many rupees per year.

In the fifth and final place, the economy has a functional aspect as a whole. It can be viewed in terms of the functions or services that it performs for the society. We can view one function of industry within the economy, namely the raw material industry of an economy. We can study the steel industry, viz., steel making, steel fabrication and steel distribution as an economy function. Similarly with the agricultural economy or the forest economy.

Forest Economy

Let us view the forest economy to study its functional approach. The study of the structure of forestry economics will help us in realising the complexities and inter-relationships of forest economy. We may divide it into five stages of production for convenience: (1) the primary production of crops and services, (2) the harvesting of forest crops, (3) the processing of forest products, (4) the distribution of forest products

and services, and (5) the consumption of forest products and services.

Firstly, land management consists largely of silviculture and protection. Here the land and its vegetation are managed in such a fashion as to grow wood and other forest crops or to provide usable water from the winter snowpack, scenic beauty for tourists, and other forest services. Secondly, there is the extraction of crops which are the outcome of the first step. It comprises the felling of trees, gathering, and other operations which are necessary to free these crops from their natural environments and then transporting them to place where they are actually to be used. Thirdly, there comes the conversion of various forest crops according to the desires of the consumer. At this stage the forest crops can also be used as raw material for manufacturing other products. This stage is again divided into two: (1) primary processing—reshaping the raw material of forest origin into different forms—is the first conversion stage. This stage consists of sawing of logs into lumber or the cooking of pulpwood into paper pulp. (2) Secondary processing consists of converting the primary products into finished goods ready for human consumption. It usually consists of one step, viz manufacturing of chairs and tables etc. out of lumber. Still the consumer product is not far removed from the forest and therefore it is related to forestry-industry. Sometimes the secondary processing requires several steps, namely the conversion of dissolving pulp into rayon thread, the weaving of that thread into some form of textile. It may include threads from non-wood fibres also, and finally tailoring that textile into some forms of garments. Take the case of rayon garments, which are almost difficult to be defined as part of forest industry. But a forest tree actually reaches an ultimate consumer through this process. Fourthly, there comes the distribution of the goods and services to the consumers. This step comprises the actual physical distribution of these goods or their transportation to different places and also the business arrangements necessary for these goods. Finally, these goods and services are used by the consumers. This is the ultimate goal of the whole productive analysis. The sum

total of the above stages is the satisfaction which the consumer derives out of their use.

If there is continuous flow of the forest products through these five channels, the forestry economy would definitely present an attractive picture in a logical sequence. But things are not quite that simple. In the first place these stages overlap in so many places. For example, the pulpwood bolts may be debarked in a debarker at the mill, making it a part of the primary processing activity. The same function can be performed by applying chemicals to living trees in the forests some times before the loggers have actually to fell them. The barks can also be removed with the help of hand tools after the trees have actually been felled and cut into bolts in the harvesting stage. But this is not a serious problem; the division of forestry operations into five artificial stages provides us with a useful analytical tool.

All the forest products and services do not necessarily have to pass through all these five stages. Sometimes there is no processing stage as in the case of firewood. The consumer derives recreational values directly. Prevention of flood needs one stage. Some times there are invisible stages, namely the distribution of forest recreation. This is done by afforesting recreational forests in the vicinity of the people according to their needs. This is also done by the reverse process namely bringing people to the recreation rather than the recreation to the people.

Need for Forest Economics

The forester has been able to gain enough experience in the field of biological sciences, viz. Forest Management, Silvicultural Aspects, Forestry Education having little consideration of economic laws, thus neglecting them mostly. These sciences have taught the profession to see trees as trees and have created a good understanding in them how to grow trees and to create quality. But if one is to understand why trees are to be grown and why resources are to be used to produce trees, then economics must take its proper place.

Economics is the proper science to allocate the scarce resources among competing means to satisfy innumerable wants

of mankind. The forester could think of living away from day to day life as long as forests were to be regarded as free gift of nature standing equally good with grazing or agriculture. As such he could mind his own business of growing trees alone. At present the main forces shaping the destiny of forestry are coming from outside the profession. Most important among these forces are economic one.

If forestry has to make its contribution to the human welfare for the world's ever increasing population, foresters must become familiar with the economic and political forces that determine most of our way of life. We must be competent to understand and to apply the basic principles of economics to the production of all goods and services which forests are able to yield.

Increasing incomes of the people are liable to raise the standard of living making room for larger and better houses requiring more wood. This creates demand for more wood and a worry for the lumberman to see if there is enough timber supply to feed the hungry saw. But if larger incomes give rise to steel, glass or brick instead of wood for construction of houses, the lumberman must think seriously about markets. On the other hand if the multiple land use does not interfere with timber production, the foresters can easily follow the path in India. Multiple use must be seen economically feasible if income from hunting rights begins to rival that from timber sales, or grazing in the forests becomes more profitable financially or the demands for municipal water gains an upper hand over production of wood. In such a condition careful appraisal of economic alternatives should be made.

Foresters are not required to learn some special sophisticated techniques of economic analysis. They can manage with the preliminary knowledge of supply and demand, of production and distribution which usually apply to any other production, viz. manufacturing of railway carriages, ready-made garments, water forage, wildlife and timber etc. The basic principles of economics remain the same but their direct application becomes a little difficult due to peculiarities of forest production process or of forest products. The principles of supply and demand, of

production and distribution apply both in capitalistic and non-capitalistic countries, with a varying degree of application.

On the basis of the above it cannot be advocated that there is no need for "forest economics" or for "forest economists". It simply indicates that forest economics is an applied field. The major problems in this field arise out of difficulties of its application rather than from theoretical ones. There is always some difficulty in applying general theory to a specific area. Forest economics generally deals with the selling, buying, owning and taxing and also managing the forest land. It may be used for the production of water, wildlife, timber or some other product. Forest economics also deals with growing, protecting, harvesting and marketing the products. On the other hand examination of interplay of forces determining the product or group of products which a particular forest land is required to produce is the responsibility of forest economics. The knowledge of forest economics to the forester is as necessary as the knowledge in other branches, i.e. forest genetics, forest management, forest protection, forest zoology, forest mensuration. The need of the modern forest manager for economic knowledge is certainly no less than his need for a knowledge of photogrametry, ecology, forest management or mensuration.

It is just because of the peculiarities of forestry that general economist is compelled to acquire a specialised knowledge of forest economics. The concept of economic principles and the approach to use them in the field of forestry should be viewed with regards to the biological nature of the resources and the time factor involved in forest production. The necessity to economize in the use of our natural resources has not yet been universally accepted. On the other hand the non-economic approach of early conservationists, particularly in India even today, could hardly persuade the economists to believe forestry performing a role other than that of a critic.

The time factor has a special significance in forestry production but it is one of the variables which is usually ignored in economic analysis. Production in forestry is a long time venture where the time factor cannot be ignored. So forestry poses some special problems which are not ordinarily encountered in economics. The time factor tends to complicate

economic analysis. Alfred Marshal, a noted classical economist described time as “.....the centre of the chief difficulty of almost every economic problem.”*

Forestry seems to be a specialised field of economic activity where man has assumed a definite role in producing wood and other forest products for the welfare of the population. For this purpose the definition broadly concerns a large part of the processing and distributing of these products. Such activities concerning the economic aspects of forestry are dealt with in some details in the chapters which follow.

Forestry is an important activity

As a rule, in general, forestry plays an important role in the economy of a country. Though it is not a major sector among producers, still it is an important activity in the economy of India. On account of the diversification of our economy, the nation produces so many goods and services required for the welfare of individuals that no single product affects the total picture of the economy to a great extent. The forestry activity contributes about 1.5 per cent to the total national income. The forest-based industries—lumber, pulp and paper, newsprint, and wood furniture and fixtures—contributed about Rs. 3200 million viz 1.71 per cent—to the national income in 1970. The wood using industries paid about 0.90 per cent of all wages and salaries in India.

After going through the above description one can easily conclude that the contribution of forestry sector is insignificant in our economy. The construction activity in India uses wooden materials; the textile industry uses rayon and other wood-based fibres. On this basis it is clear that much of our transportation, wholesale and retail trade services are being done in wooden products (For details see Chapter 6—Forest Products and Chapter 15).

Forest Economy of the World

Since the country is in the process of industrialisation, the economic importance of forestry has not come to the forefront. Wood products show up in innumerable places and often are

*Marshal, Alfred : Principle of Economics, Macmillan and Co. Ltd. London. 1947

used in producing other goods and services. Railway lines run on wooden sleepers, the bodies of trucks and lorries are made of wood. People who are living on the rolling plains devoid of tree growth still have a chance to see wood on all sides in the buildings and furniture, tools and sporting goods, pencils and toys. Our huge organisations in business, banking, insurance and publishing are dependent on the use of enormous quantities of paper—almost entirely a product of wood.

The total picture of forest products is not yet complete. It is just possible that the water yield of our national forests might have a value greater than that of the annual yield as timber. Nearly 50 thousand people seek recreation in the national parks each year. Many thousand hunters find their living on the forest land. Thus forests influence the lives of many people in the country in different intangible ways. The belief that forests improve the atmosphere is no longer prevalent in the minds of the people.

It is distressing to note that forestry is not holding its own in the changing economic situation in India. The proportion of national income produced by agriculture, mining, and transportation has increased their share of the total national income. Though the income from forestry has also increased but relatively at a lower pace. The increase in income has occurred on account of (1) higher prices of the forest products and (2) over felling viz. eating into the capital. Production in forestry has not been able to adjust itself enough to keep on producing what the people need. The higher production of firewood and low of industrial wood is the relative feature of backward economies of countries like India. Forestry is needed to grow wood at a faster rate than it is being produced at present to keep pace with the fast growing economy as it has not been able to do so in the past. This may enhance the importance of forestry considerably.

CHAPTER 3

Economic History of Forests

The economic history of Indian forests is closely connected with the country's history and its demographic pressure. Political changes brought in new reforms in forest administration also. The development of forestry on scientific lines received a set back on account of the two World Wars. Forestry in India covers a vast area having varied climatic conditions. The dense population, human and bovine, has an ever increasing demand on the different types of forests. Hence the economic history of Indian forests is quite chequered and interesting. Forestry has developed at a fairly fast speed in India. India has made a marked progress in the fields of tropical silviculture, forest conservation and forest management.

Very little information is available in respect of forest administration in the country prior to the British rule when regular forest operations began. In the early days population was sparse and hence it was not necessary to exploit forests extensively. But the increase in population has necessitated larger areas of land to be brought under cultivation. Consequently, land had to be deforested and brought under cultivation. The population pressure began to tell upon forests which resulted in clearing large areas of forest land unsuited for permanent agriculture. Trees were cut and burned in the process. The land lost its agricultural productivity within a few years and the small farmer repeated the clearing process.

Early existence of Forests

Forest came into existence long before there were fields. From time immemorial, man has been converting forest lands into fields. His pressing needs for agriculture had naturally to be given high priority over the standing forests. The extermination of forests by him or by means of excessive grazing by cattle, sheep and more seriously by goats is definitely visible in

backward countries. A Frenchman has aptly put it—"man finds forests and leaves deserts". Another authority on forests says "And nature, outraged, has swamped his fields with flood-water, has buried them in sand and boulders, cut them up with ravines or carried them bodily away". Dire necessity compelled man at last to recognize his long outstanding debt and to repay it. This recognition gave belated birth to Forestry, comprising trees and shrubby growth. This is a new sort of husbandry endowed with fast expanding art. This art is no less than agriculture but hardly appreciated or understood by common man for whom it is vital for getting livelihood and for his well-being.

Social Forestry

Since the inception of forestry—altogether a new kind of husbandry—the foresters have always treated trees as their friends at the cost of society. Now-a-days the role of society in the forests is coming in the forefront and it seems that forestry is concerned with people as much as it is with trees. This peculiar idea is spreading fast in the world. One wonders why such an outlook has been ignored so far in the world. The idea that forestry is nothing but a society-oriented activity has been clearly brought out in day-to-day life.

Forestry began to be preached or practised with the novel idea that society exists for forestry rather than the other way. But like almost every economic activity forestry seems to be confronted with a long gap between cause and effect. In fact, forestry education has been faulty in so far as it has made forests very slow in responding to changes imposed on them. Posterity might perhaps blame the present generation of foresters for the incorrect course adopted by them.

In the real sense, forestry is related to two biological systems—the forests and the society. The society comprises very diverse activities which tend to make the problems of forestry more complex than the forests themselves. Forestry education has taught the profession quite effectively how to handle the complex problems of the forests. But this education has not been up to the mark in so far as handling the problems of forests in relation to complex problems of the society is considered.

It is not the fault of the forester because he has been educated in a period when the profession was unable to see people for the trees. The complexity of the society cannot be studied by the so-called scientific methods. Therefore it has been much easier and more productive in terms of measurable results to concentrate on the relatively more passive one of the two systems. This system still seems to control forestry. But really as the proper study of mankind is man, the proper study of forestry is society. Forestry is therefore incomplete if bereft of society.

Forests in Ancient India

The pre-British period experienced successive waves of invasions and immigration into India which left their scars on the forests in this country. There is evidence of a flourishing Dravidian civilization about 2,000 B.C. The population was sparse in those days and the forests were in abundance. Consequently the growth of forests was not adversely affected. Afterwards the Aryans, a pastoral people, cleared large tracts of forests for expansion of cultivation. They treated trees to be their enemies, not friends. The population pressure began to tell upon forests which resulted in clearing large areas of forest land unsuited for permanent agriculture. The trees were cut and burned in the process. The land lost its agricultural productivity within a few years and the small farmer repeated the clearing process. The Mahabharata and the Ramayana contain attractive descriptions of the forests of Dandakaranya, Nandavana and Khandavana. Even the concept of wild life preservation finds support in "Ahimsa Parmmo Dharma" (Non-violence is the supreme creed). The records of Alexander's invasion (327 B.C.) refer to dense forests in the north-west region. A superintendent of forests was appointed in the reign of Chandragupta Maurya (300 B.C.). The staff assisting him took great care of the protection and preservation of wild life. The forests in those days were classified as (i) those set apart for the study of religion, (ii) reserved forests for the supply of forest produce, (iii) grazing grounds of the royal elephants, (iv) hunting grounds for the Royalty and (v) hunting grounds for the public in general. During the reign of Asoka the Great much importance was attached to tree planting along roadside

and on camping sites. Growing of medicinal plants and herbs was also encouraged.

Forests in the Muslim Period

When Muslims invaded the country, some people fled into the forests for fear of life and cleared them for settling down there. The invaders were not interested in the conservation of forests. Their interests were confined to hunting, creating and maintaining gardens, besides planting trees along the banks of the canals and highways. The rise in population also led to the clearance of more forests for increasing agricultural areas under economic pressure. With the fall of Moghul Empire, the country was divided into a number of small kingdoms that were frequently fighting among themselves. As a result many people abandoned cultivation in disturbed areas and resorted to remote forests areas. One thing is notable that royalty was collected for extraction of trees which were proclaimed by the local rulers as "Royal trees", e.g. shisham (*Dalbergia sissoo*) and sal (*Shorea robusta*) etc. which were having timber value.

Forests in early British Period

However, heavy exploitation of timber resources of the country took place during the early British period. The Britishers appeared to have an impression that forests in India were inexhaustible, and hence they did not care to husband them wisely. They were not perhaps even aware of systematic forestry in the beginning. At many places, forests were taken as an obstruction to agriculture. The general policy was to allow agriculture on forest lands to secure food for the increasing population.

First steps towards Forest Conservation

The first steps in Indian forestry towards conservancy began in the south in Malabar forests. Felling of teak below the girth of 21 inches was banned. The Britishers took this step because they wanted to ensure wood for their navy and not because the Indian people needed it. A Forest Committee set up in 1805 A.D. noticed that the more accessible forests had been over-worked and that construction of roads even at a high

cost was absolutely necessary for tapping the distant areas of virgin forests. The Government of Madras (now Tamil Nadu) appointed Captain Watson of Police Department as Conservator of Forests in the year 1806, but this post was abolished in 1823 as he proved unequal to his assignment. Conolly, the Collector of Malabar, initiated action in 1842 A.D. which created the world famous teak plantations of Nilumber. His assistant Sub-Conservator Chathu Menon, worked day and night ceaselessly for these plantations.

In 1825 Wallich was deputed by the Government of India to examine the extensive forest areas at the foot of the Himalayas. He recommended the conservation of the forests of sal (*Shorea robusta*) and shisham (*Dalbergia sissoo*) in Avadh (now Uttar Pradesh) and the Terai. But Forest Department never felt the necessity of checking even undue exploitation of forests—thinking that the forest wealth of India was inexhaustible. The unchecked exploitation of accessible forests, the forest fires and grazing added to the cause of gradual destruction of forests in the plains.

The Bombay Government appointed Gibson in 1847 as Conservator of Forests in addition to his other duties. Cleghorn was appointed as the first regular Conservator of Forests in 1856 in Madras Presidency to institute action towards forests conservancy there. With these appointments regular steps at forest conservancy began to be undertaken in Bombay and Madras Presidencies. The forests of Bengal and Central Provinces were altogether unexplored at that time. Very little information was available in respect of forests and their management in Upper India during the early British rule.

Lord Dalhousie deputed Captain Longden to explore the forests of the Western Himalayan Range from Chamba to Simla. As a result of his exploration of the forests in the valleys of Sutlej, Beas, Ravi and Chenab in 1852-53, a Timber Agency was established on his advice and had a depot near Sialkot. A superintendent was appointed for the forests in Dehra Dun and Rohilkhand in 1854.

Lord Dalhousie, the Governor General, promulgated an outline for forest conservancy in respect of the country as a whole for the first time in 1855. It was termed as the "Charter

of the Indian Forests". Brandis, who became the first Inspector General of Forests in India later on, was appointed as Superintendent of Forests in Pegu (Burma) in 1856

On the initiative of Cleghorn, the British Association in Edinburgh formed a Committee in 1850 to consider some effective checks for putting to an end the reckless destruction of tropical forests in India. The Committee felt that mass-scale destruction of forests was continuing over a large portion of the Indian Empire on account of the careless and wasteful habits of the people in general and convenience of the British rulers in particular because of their vested interests. It was also observed that there was considerable improvement in areas where the British rulers exercised adequate care and control. It was expected that improvement might take place over large areas by proper control and enforcement of regulations to the forests over the rest of the country too. The Committee observed that indiscriminate clearance of forests around localities from where water supplies were derived was to be greatly deprecated. Cleghorn published his book "Forests and Gardens of South India" in 1861. This book became a source of promoting forest conservancy in India. He laid the foundation of an effective system of forest conservancy in Madras (now Tamil Nadu). He also contributed to the development of forestry in the Punjab. He was associated with Brandis in 1864 for organizing Forest Administration under the Government of India. The Madras Forest Act was passed in 1882.

Just after the Indian struggle for independence in 1857, the East India Company was disbanded in 1858 when the Royal Proclamation declared the sovereignty of queen Empress Victoria of India. By this time the Britishers had realised the need of rapid communications, with the prime object of moving the military forces throughout the country. The second objective was to explore the hinterland of the country for collecting raw materials to be exported to England to feed the industrial units there and in turn flood the Indian markets with goods manufactured in England so that the people in India could not think of industrialisation of the country at least during the British regime. Their interest lay

in exporting raw material from India to England and importing the finished goods into India from England. The third objective behind the policy of non-industrialising the country was that India should basically remain an agricultural country so that foodgrains could be exported to England which does not produce enough foodgrains for her people. With these objectives in view, the construction of railways was taken up for making the British rule more secure in India. There was a constant demand on forests. During the early years of British rule in India, the Britishers exported large quantities of timber to England for their navy. Large quantities of teak were exported from India to England for the use of the British fleet because of shortage of first class oak timber there. Apart from timber, sandalwood was extracted from South India for its highly scented wood, and exported to the European markets. Thus forests were required to supply enormous quantities of railway sleepers and other timber. The construction of railways even enhanced the demand on forests for supply of charcoal for running the railways so long as they were not switched over to hard coke which became available at a much later stage.

Gibson, on his appointment as Conservator of Forests, adopted a policy of forest conservancy by (i) putting a ban on shifting cultivation, (ii) carrying out thinning in young teak forest areas and (iii) forming teak plantations. Some of the District Collectors did not however cooperate with him in the matter. The Bombay Government recognised the need of having strict regulations about conservation of forests because of the growing scarcity of timber. In 1860, Dalziel, who succeeded Gibson drew up a set of rules in consultation with Goldfinch, the then Collector of Dharwar. Temple, the first Chief Commissioner of Central provinces (now M.P.), began to pay proper attention to forests in 1861. Captain Pearson was appointed as Superintendent of Forests. He felt the need for forest conservancy in those areas where reckless deforestation was going on. He was assisted in his work by Lt. Forsyth and Lt. Douglass. The former wrote his book "The Highlands of Central India" giving vivid description of those forests at that time. Pearson and Brandis decided in 1863 that further

forest conservancy work should concentrate on (i) demarcation of reserves, (ii) protection of forests from fire and (iii) assessment of resources to enhance forest revenue. Pearson was able to organise a regular Forest Department by 1870.

The Western Himalayan forests experienced heavy felling 1858-64 for meeting the demand for sleepers needed for laying out new railway lines in Upper India. The Governor General directed Cleghorn of Madras Forest Department to proceed to Punjab for an investigation into the affairs of the forests there. In 1863, Reid was appointed Superintendent of Chamba State Forests. No serious effort towards forest conservancy was made in North-West Province and Avadh till the middle of the 19th century. Ramsey, the then Commissioner of Kumaon and Garhwal, was appointed as ex-officio-Conservator of Forests. He took adequate steps to stop destruction of forests in the Hill districts. In 1862 the Government of India directed Brandis (Superintendent of Forests in Burma) to visit India and report in respect of Forests there. After his visit to Bengal, Avadh, the North-West Province and the Central Provinces, he advised the Government of India on the steps to be taken to restore forest conservation. After this, Webber was appointed as a Forest Surveyor in North-West Province (now U.P.). A regular Forest Department came into existence in 1868 in North-West Province where Webber wrote the book "The Forests of Upper India" with a vivid description of the forests there. In 1864, Anderson was appointed Conservator of Forests of the Lower Provinces in addition to his duties as Superintendent of the Botanical Gardens at Calcutta. This was thus the beginning of forest conservancy in the Lower Provinces.

The Beginning of Forest organization

In his despatch on 1st November 1864 the Governor General made the proposal for establishing a separate Forest Department. It was accepted by Her Majesty's Government. Brandis was appointed as Inspector General of Forests and Cleghorn was deputed to assist him. They developed a methodical system of forest management in India. The Indian Forest Act of 1865 came into being on their advice. It was the

first attempt at forest legislation by the Britishers in India. This act empowered the local governments in the Provinces to draft rules for enforcement in respect of forests in their respective regions. Some of the local Governments lagged behind in its application to their territories, but all the areas under British rule had either extended the Indian Forest Act to their territory or brought out special Acts by 1882. As Inspector General of Forests, Brandis took steps to recruit trained personnel for controlling the forest work and establishment of the Forest Department. In 1869 there was a reorganisation of the Forest Service of various provinces into Conservators, Deputy Conservators and Assistant Conservators. Brandis also took steps to arrange training to Forest Probationers in forestry in Europe. First of all Schlich, who became a world-renowned forester and Ribbentrop who succeeded Brandis as Inspector General of Forests, were selected for training. Both of them reached India in 1867. Brandis proposed that (i) facilities should be provided to the officers already in the forest service in India to receive further training in scientific methods in forestry in Europe and (ii) young men should be selected in Europe for training on the continent before they joined the Indian Forest Department. He made proposals for appointment of Forest Rangers.

Beddome, the Conservator of Forests wrote the first "Manual of Forest Operations" in Madras about 1863. This was the first attempt towards forest management according to a regularly drawn-up working plan. Casuarina was planted during the period 1865-70 in the coastal areas of Madras for making up the deficiency of fuelwood created by the removal of existing forests to meet the heavy demands put forward by the railways. The supply of fuelwood to the railways at this time was the major function of the Forest Department. Such a situation remained till such time as hard coke began to be used in railway engines. Stewart, the first regular Conservator of forests in Punjab, conducted enquiries in respect of fuel supplies needed for the railways in that region in 1864. There was a continuous supply of railway sleepers from the forest of Punjab. The first attempt to raise deodar (*Cedrus deodara*) plantations met with failure. Stewart advised the Forest Department to conserve the existing deodar forest resources rather than create

new plantations in the Western Himalayas. He introduced the Shelterwood system which was successfully adopted in Punjab. The conservancy of forests in the North-Western Provinces remained in the hands of Commissioners up to 1868. Pearson on his transfer from the Central Provinces, took over as the first Conservator of Forests in North-Western Provinces. Reid, the Conservator of forests in Avadh introduced conservation of forests on systematic lines. Climber-cutting was done over large tracts of forests. Great progress was achieved in respect of survey and demarcation work during that period. Mann examined the forests of the districts of Lakhimpur and Sibsagar, Nowgong, Naga Hills, Khasi and Jaintia Hills on the south side of Brahmaputra in 1868.

Organisation of Forests Under Regular Management

Brandis laid a sound foundation of the Forest Department by 1870. With the setting up of a regular forest service, management of forests was bound to improve. The period between 1871-1900 experienced the preparation of Working Plans. At that time the main task of the forest officers was exploitation of the forests under their charge. After this, the arduous task of demarcation of forests, was taken up. The forest officers at that time performed this duty with the handicap of inadequate equipments coupled with poor communications. A revised Indian Forest Act (Act II of 1878) was passed in 1878 which extended to all Provinces of British India except Madras, Coorg, Burma, Bihar, Ajmer and Baluchistan. It was mainly meant to rectify the lacuna in the Indian Forest Act 1865. It was unfortunate that Madras which had given the lead in introducing forestry and forest organisation in India should have refused to adopt the Indian Forest Act of 1865 extended to Madras Presidency. Later on, Brandis submitted his report which made Madras Government appreciate the need to have a Forest Act for the scientific and effective management of forests. During the period 1880-1900 forest settlement was actively in progress in various Provinces. At that time about 9 per cent of the country's forest area was termed as 'reserved' forests. Therefore the local Governments were requested to set apart more area under 'reserved' forests.

During the period 1871-1900 further steps were taken for imparting technical education and training to all the person required to man the executive branches of the Forest Service. Early pioneers in forest service came from the Army or the Police, or other branches of Public Service. In 1885 a Forest School was started at Dehra Dun for training Rangers needed to serve in different parts of the country. In 1891, a Provincial Forest Service was constituted for recruiting suitable forest officers in India. Considerable progress was seen in Forest Administration during 1871-1900. The first three All-India Officers (Brandis, Schlich, Ribbentrop) helped to establish the forest administration on sound footing. They emphasized upon the government the need for scientific advice on forestry matters. During their period, the Forest Administration was geared up and reorganised in various Provinces.

Present Century—Progress of Forestry under British Rule

The next stage of progress in forestry is marked in the first quarter of the present century in India. This period witnessed a general progress in the different fields of forestry. In particular, the scientific aspects of the profession were attended to more carefully. The Imperial Forest Research Institute was established at Dehra Dun with six officers—(1) Silviculturist, (2) Superintendent of Forest Working Plans, (3) Forest Zoologist, (4) Forest Botanist, (5) Forest Chemist and (6) Forest Economist. Lord Curzon inaugurated the main building of the Forest Research Institute at Chandbagh, Dehra Dun. The World War I (1914-18) affected the forests of the country very badly. With a view to meeting the situation created by the shortage of imported wood material, the Forest Research Institute undertook research to find out the suitability of local timbers.

A separate North-Western Frontier Province was formed in 1901 and the North-Western Province was renamed as the Agra Province. Soon the United Province of Agra and Avadh came into existence. The year 1911 experienced the formation of a composite Bihar and Orissa Province. The formation of different Provinces was a healthy move for ensuring better management of forestry areas which did not get adequate atten-

tion before. The forest administration felt the urgent necessity of preparing forest working plans on scientific lines. The Inspector General of Forests toured different provinces to advise the local governments on forest administration. In 1905 the Government of India suggested that every province having more than three Conservators of Forests should have a Chief Conservator of Forests. By 1921 every state except Bihar, Orissa, Bengal and Assam had a Chief Conservator of Forests. Divisions were bifurcated for purposes of intensive management. More forest personnel was appointed to cope with the increased work. A Board of Forestry with Conservators of Forests as members and the Inspector General of Forests as President was constituted in 1910. The Board used to meet after every three years to discuss the programme of research and problems arising out of general forest administration.

The Royal Commission on Decentralisation (1909) recommended that the Inspector General of Forests should not be bothered to advise on the working plans. The Chief Conservator of Forests was considered sufficient authority for final scrutiny and check up of the working plan. The Inspector General of Forests could advise only if the local government sought his advice.

The next stage in the economic history of forests in India is the period 1926-47. In 1926 the post of Inspector General of Forests and that of the President of the Forest Research Institute were amalgated in one. For a long time there was a general thinking that the post of the Inspector General of Forests should be abolished but later on this post gained more importance. The Chief Conservators of Forests became the independent heads of the forest departments in the provinces. The Indian Forest Service was commenced in Dehra Dun from October 1926. In 1938 the Indian Forest College was started at Dehra Dun for imparting training to Gazetted Officers of the various provinces. After the Indianisation of the Forest Service in 1922, local officers became a common part of the Indian Forest Service. After the promulgation of the Forest Act of 1935, the forests became a transferred subject entirely under the administration of the provincial government. The

Government of India and the Inspector General of Forests were concerned only with the general aspects of forestry, viz., Forest Research, Forest Education, etc.

The Forest Research Institute shifted to its present building "New Forest" in Dehra Dun from its old premises at Chandbagh in 1926. The research branches and other sections were greatly expanded under the guidance of Clutterbuck, the then Inspector General of Forests. All this became necessary for meeting the situation created by World War II and the Post-War conditions. During this period the demands on forests were of a larger magnitude than those during World War I. After the war had ended, Howard, the Inspector General of Forests, prepared a paper on the post-war forest policy for India for rehabilitating the overworked forests. Consequently a number of post-war schemes were implemented for the development of forests. Many new forest-based industries like the newsprint factory at Nepa Nagar in Madhya Pradesh were started in the country.

Economic Exploitation and Utilisation of Forests

The table on next page depicts the picture of annual outturn in respect of timber and fuel in India from 1936-37 to 1947-48.

An analysis of the table overleaf reveals that the production of timber and fuel was stepped up during the war years by 32 per cent over pre-war period to meet exigencies of Defence supplies. The highest production was in 1945-46 when there was an increase of about 62 per cent over pre-war years. Although the outturn during the post-war years has gone down, it still remained about 41 per cent above the pre-war years. The exploitation was maintained at such a high level on account of the following reasons:—

- (a) Construction of new roads and paths for tapping the virgin forests which were mostly inaccessible during the World War.
- (b) Application of mechanical devices not available before the war.

Table 1¹ Annual outturn of Timber and Fuel in India from 1936-37 to 1947-48

Years	Thousand tons.	Outturn per sq. metre of forests (tons)
(a) Average—pre-war years 1936-37 to 1938-39	4,379	21
(b) War-years		
1939-40	4,823	21
1940-41	4,989	22
1941-42	5,037	23
1942-43	5,497	26
1943-44	6,023	28
1944-45	6,867	32
1945-46	7,115	31
(b) Average—War-years	5,764	26
(c) Post-war years		
1946-47	6,327	27
1947-48	6,074	26
(c) Average—post-war years	6,200	26.5

(c) The Forest Department took up closer conservation to meet accelerated demand for timber for construction and other purposes.

(d) New industries began to accept the species not in demand before the war.

(e) The forests in the Andamans began to supply increased yields and also unsaleable timber began to find a ready market.

(f) The standard of living of the people went up.

It might not be out of place to mention that timber species like sal (*Shorea robusta*), chir (*Pinus roxburghii*) shisham, (*Dalbergia sissoo*), etc. which were in heavy demand for meeting the requirements of defence, had mainly to bear the burnt of the excess war fellings.

¹Explanatory Memoranda for the Central Board of Forestry 7, 8, 9 May 1951. Forest Research Institute and Colleges, Dehra Dun, Ministry of Food and Agriculture Government of India.

(The original table was in per sq. mile).

The revenue from forests in India during the decade under review has been as follows:

Table 2 Revenue from Forests in India from 1936-37 to 1947-48

	Average revenue	General index of timber prices	Revenue in terms of pre- war	Net rise in revenue over pre- war period
	Rs. million	Sal (Logs)	Rs. million	Percentage
(a) Pre-war years 1936-37 to 1938-39	25	100	25	—
(b) War years 1939-40 to 1945-46	63	145	43	72
(c) Post-war years 1946-47 to 1947-48	102	320	32	28

The actual rise in revenue is not so phenomenal as it appears at first sight, because in the meantime timber prices had also exhibited an inordinate increase. Since sal is the major species which grows in India, it is better to treat other woods in terms of sal wood. In fact similar price trends were discernible in other timber species such as deodar, chir sissoo, teak, etc. The actual increase in forest revenue in terms of money amounts to about 28 per cent only in the two post-war years. Viewed against increased production of timber which amounted to 41 per cent during the two post-war years, the forest revenue has not registered a corresponding increase. The conclusion is inescapable that timber prices in terms of money are fairly low and not prohibitive as it is commonly believed.

Historical Development of Forests under the Five Year Plans

At the time of attaining Independence, there was a regular organisation for forestry activities. The forests in India were being worked out according to working plans scientifically

drawn in advance. These working plans were being periodically revised. The management of forests usually meant improving the composition and growing stock of the forests by adopting good silvicultural practices and by artificial regeneration. The main emphasis was laid on conserving forest capital for attaining 'normal' forests. Forests were being worked on a sustained yield rotation. The expenditure on forests was laid for improvement, such as cultural operations, construction of roads, etc. keeping in view the revenue earning potential of the forests in a particular region.

After integration of princely States with the Indian Union, the development of their forests became the sole responsibility of the State Governments. Estates Acquisition Act was promulgated in most of the States in early fifties. Thus large tracts of private forests held by ex-Zamindars came to be vested in the Government. The degraded or denuded forests were attended to specially.

The First and Second Five Year Plans (1951-61)

The main activity during this decade was focussed on the rehabilitation of the degraded forests and also on creation of plantations of industrial and economic importance. Such species were mainly suitable for match-woods and other commercial uses. During the Second Plan, conservation of wild life received special attention by starting several wild-life sanctuaries.

The Third Five Year Plan (1961-66)

The Third Five Year Plan evinced special interest to meet the long term requirements of the country. During this period more efficient and economic utilisation of the valuable forest products was ensured. The main aim was to increase the output from the existing forests by means of better techniques of timber extraction, improvement of communications and by putting the commonly known Indian timbers of secondary importance to use, after proper preservative treatment. The main aim of different schemes during the Third Five Year Plan was to attain self-sufficiency in industrial timbers, fuelwood and other forest products and to undertake large scale plantations of industrially

valuable species. A new Centrally sponsored scheme "Plantation of Quick Growing Species" was initiated in the States. Pre-investment Survey of Forest Resources was introduced in collaboration with the United Nations Special Fund (UNSF) and Food and Agricultural Organisation (FAO). This project was initiated mainly to investigate the availability of raw materials in the possible industrial catchment areas to determine their economic viability. As a matter of policy improved logging tools were used with a view to obtain higher timber yields from the forest areas under exploitation and to minimise the wastage. A logging training centre was set up with the assistance of UNSF for imparting training to forest officers, field executives, leasees and forest contractors in the States.

The Annual Plans (1966-69)

Specific emphasis was laid on plantations of quick growing species and modernising harvesting and plantation techniques during the three annual plan years (1966-69). This was done mainly with an idea to consolidate economic gains.

The Fourth Five Year Plan (1969-74)

Three main objectives were in sight during this period in the forestry sector. These were: (a) to increase the productivity of forests, (b) to develop forests for supporting rural economy and (c) to create a linkage of forest development with various forest-based industries. Short term and long term requirement in respect of agricultural and industrial sectors were emphasised to be met from the forest development activities. Quick growing species and species of economic and industrial importance were created in large scale plantations. All this was done with a view to achieve self-sufficiency in forest products within the earliest possible span of time, especially in respect of pulp, paper, newsprint, wood panel products and matches. This was done to discourage the imports of some of these items and to boost the export of pulp and wood panel products.

Financial Achievements

Of the total expenditure of Rs. 1177 millions incurred during 1951-69 on the forestry sector, 23 per cent has been

shared by economic plantations for industrial and commercial uses. During the Fourth Five Year Plan the same percentage of expenditure was maintained on these programmes. However, the plantations of quick growing species shared about 11.4 per cent of the total expenditure during 1951-69. The low percentage is due to the late start of this scheme during the Third Five Year Plan period. The expenditure on this scheme showed a rise to 18.9 per cent during the Fourth Plan period. The expenditure on Farm Forestry-cum-Fuelwood could not pick up well as it rose from 2.2 per cent to 4.1 per cent of the total expenditure on this scheme.

The Fifth Five Year Plan Period (1974-78)

The primary objective in the Fifth Five Year Plan is to take up a dynamic programme of production forestry, aiming at clearfelling and creating large scale man-made forests with the help of institutional financing. The sale proceed from clear-felled areas is also proposed to be utilised in wood-based industries by locating additional units wherever required. Development of farm forestry on a large scale and to improve degraded forests to increase the fuelwood and small timber supply for the people in rural areas. A proper forest survey will be required to assess the present growing stock, increment and potential increments by forest divisions, natural regions and States along with a proper information system.

The establishment of man-made forests and forest-based industries will be done through a net work of State Forest Corporations. The use of Project Planning approach will be done on wide scale. During the Fifth Five Year Plan, a number of projects are proposed to be prepared in various States in respect of short term and long term benefits to increase the raw materials for industries and additional revenues at different levels of investment.

A new feature of the Fifth Five Year Plan is that commercial forestry, which was absent so far in the country, is going to be introduced. For this purpose a tentative outlay of Rs. 248.5 million has been provided as share capital of the equity in Forest Corporations. This scheme is likely to cover about sixteen

States and two Union Territories namely, Andhra Pradesh, Assam, Bihar, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal, Andaman & Nicobar Islands and Arunachal Pradesh. So far these corporations have been established in 16 States.

The following table shows the financial position in respect of the Forest Departments in India.

Table 3 Average Annual Revenue, Expenditure and Surplus of Forest Departments in India.

Period	(Rs. million)			
	Average Gross Revenue	Expenditure-Plan & Non-Plan.	Surplus	Surplus as percentage of gross revenue
1951-52 to 1953-54	21.01	10.62	10.39	49.45
1956-57 to 1958-59	41.48	17.12	24.36	58.72
1961-62 to 1963-64	69.38	32.23	37.15	53.54
1966-67 to 1968-69	107.50	56.63	50.87	47.32
1969-70 to 1971-72	135.87	73.79	62.08	45.69

The average expenditure on Plan and Non-plan in forestry sector represented 50.55 per cent during 1951-52 to 1953-54. It increased to 54.31 per cent in 1969-70 to 1971-72. This expenditure has not been sufficient to give boost to produce enough raw materials in the country for the increased activities of the forest-based industries to produce finished goods for the fulfilment of the requirements of the ever increasing population. It has not been in the same proportion as the increase in food grains either.

The trend in the outturn of major forest produce for the past 15 years or so may be seen from the recorded production of wood in India, shown on next page.

It is clear from the table on next page that the production of industrial wood has more than doubled. But the requirements of the ever increasing population in the modern age of industrialisation have increased by leaps and bounds and have crossed all limits. The production of fuelwood has not increased proportionately.

Table 4 Production of wood in India.

Year	Million m ³ (t)	
	Industrial wood	Fuel wood
1956-57	4.46	10.18
1961-62	5.43	10.75
1966-67	9.28	12.24
1969-70	8.93	12.86
1970-71	9.12	13.70
1971-72	8.37	13.70
1972-73	8.47	13.14
1973-74	9.12	15.21

Forest Planning

Prime Minister Jawahar Lal Nehru of India defined Planning more simply and pragmatically :—

“Planning is the exercise of intelligence to deal with facts and situations as they are and find a way to solve problems.”¹

Planning is a complex and many-sided phenomenon. It has been defined widely in different ways. For instance, one writer though thinks it “big and complicated” considers it “not much more than applied common sense”². In the view of another writer it is “a complex clustering of problems to be ‘explored’, not defined”.³ However, most writers consider planning as an organised, intelligent attempt to select the best available alternative to achieve specific goals. It connotes the rational application of human knowledge which takes us to certain decisions which serves as the basis of human action. However, the central core of the meaning is to establish a relationship between means and ends with the object achieving the latter by the most efficient use of the former.

Planning may be used for so many purposes. For example, Planning to wipe out poverty, National Planning for Economic Stability or Economic Development. Economic planning is done in such a way that our scarce resources are employed to yield us the highest satisfaction.

¹ Nehru, Jawahar Lal “Strategy and the Third Plan”, pp 33-34.

² Morrison, Herbert “Economic Planning”, p 15.

³ Elliot, John E., ‘Economic Planning Reconsidered’, p 55.

In an agricultural country like India, forestry has to play an important role in economic development. The concept of planned economy in the forestry sector in India began in 1950 with 22.48 per cent of the total geographical area under forests. The area under forests in 1971 was 22.97 per cent and it stands at 22.87 per cent of the total geographical area of the country in 1976.

Forest Planning is aimed at optimizing the utilisation of resources, which are needed to serve social, political and economic ends. In a nutshell the planning involves choosing among several courses of action. However, planning associates problems in general, but there are special problems in the way of forest planning. These problems are more acute in nature in respect of large enterprises like forestry sector. The long rotation period of tree crops, the spatial distribution of forest estates coupled with vagaries of nature and markets—all create problems.

Planning is likely to cover everything from a series of arbitrary or dogmatic decisions to a critical and sophisticated investigations into the whole range of possible choices open to an enterprise. Firstly, planning begins with collection and assembly of data. Secondly there comes the stage of examination of data and fix appropriate criteria of various possible courses of action.

Finally, the plan formulation is taken into consideration. The forests—natural and man-made plantations—all are influenced by economic and political forces, wind, weather, diseases and fire etc. Therefore the productivity, operational techniques, the profitability and even long-term objectives are all liable to change. The forestry, being a long term venture, cannot be managed on day to day basis. Short term decisions in forestry have a great influence for long time to come. Planning in forestry have a role to keep both continuity and elasticity in equilibrium. Therefore the fundamental objectives should not be altered with every new and not necessarily stable situation. Forestry requires plan of a general nature indicating long-term policy objectives. Permanent change in circumstances necessitates their revision. An annual plan which forms the basis of

annual financial budget, sets out the programme necessary for implementation of the aim of the plan.

The planning process in forestry becomes elastic owing to complexity of environments. If circumstances are otherwise the obvious choice lies on experienced forest officer to write a detailed plan.

The Control of Plans

After the plan is ready, it is necessary to implement the plan in right earnest unless it becomes obligatory to amend it owing to changing circumstances.

Controls are divided into two types. (1) There is a retrospective comparison of the results achieved at the end of a budgeting period, which is usually one year for this type of control. The retrospective comparison involves three objectives. In the first place management at each level has to exercise a certain degree of discipline over the subordinate levels. This is done to see that approved budgets are followed as closely as possible. Secondly, achievements are compared for preparing budgets for succeeding years. Finally, achievements are compared over a period of several years to provide a basis for adjusting the long-term plans in the light of changing events. It cannot be of much value to compare only the prescribed quantities of work with those actually achieved or the estimated expenditure per operation with the actual expenditure. To make it meaningful to manage the quantities, costs and revenue have to be put together to make them comparable with the prescribed and the actual quantities, unit costs and revenues.

The second type of control remains in force constantly throughout the budget period. The retrospective type of control described above is not of great help to the forest manager to achieve his budget during the year. It is of help to him if he is able to know the progress from week to week in respect of various operations. It helps him to know if the unit costs compare well with his estimates in the budget. Then the yearly budget has to be subdivided into short-term targets. It may have likely to be amended in case the weekly or monthly targets are not achieved. Therefore, the principle of flexibility stand equally

good in case of one-year budget and longer-term plan. Forestry confronts with this major problem which is very important for the local manager. However, this type of data are not easily processed into a meaningful form at the forest level.

It depends upon the type of operation as to what method of control is applied there. For example, a network planning may be necessary for a complex project having a target completion date and involving many intrincating operations. A plan to provide plywood logs for a mill so that the average haulage distance, weighted by volume, is kept within a predetermined number of kilometres, requires the maintenance of record of cumulative volume against average haulage distance throughout the year which may constantly be compared with the production targets of the forests in the supply area.

Therefore, it is necessary to consider what type of data is going to be received by those responsible for implementing it before formulating the plan.

Network Analysis

Network analysis is a fast developing tool of management planning which is very easy to learn and consequently apply. This method is used to 'coordinate and control a large number of concurrent activities which are directed towards the same goal'.¹ Diagrammes are used to show the interrelationship of all these operations and to estimate the time needed to complete each one of them. A series of operations is determined in advance to show the completion date of a project as a whole. This series of activities is known as the critical path. The completion of the whole project is likely to be delayed if there is a delay at any stage in the critical path. As work proceeds the critical path may adopt its own course if time fixed for some operations is altered. Network analysis is, therefore, not used simply to plan a project in advance but also to control its progress as the work proceeds.

Forestry sector is the right place where network analysis could usefully be applied to the planning of plant production.

¹K M. Smith, 1965. A Practical Guide to Network Planning. British Institute of Management.

Completion of a planting programme depends on the allocation of plants. The time factor in this case enters into new dimensions in a multifarious ways. Losses are likely to occur during the production period of a plant. Simultaneously the type and extent of land may differ. All these factors may lead to alter the type of plant and number required.

Optimal Inputs

It seems that under-productivity of forests is the major problem in India. In this situation it becomes essential to intensify management practices, especially in those areas which possess high developmental potential. Such areas as have slow growing species, may need replacement of the existing species with quick growing species or those trees which have industrial value. It is noteworthy that even forestry which has been placed on comparatively short rotation is working on the minimum inputs. Unless the inputs are increased to reach the optimal level to take care of such contingencies as abnormal climatic conditions, insects and pests etc., it is not possible to maximise the output from forests. Use of irrigation, fertilizers and of pesticides, bacterial and mycorrhizal inoculation for pinus species combined with the use of superior genetic strains are counted as some better means and ways to achieve good results. All this is impossible within the small amount of investment allocated to the forestry sector. Though optimal utilisation of resources is necessary, measures like fire protection are also called for.

CHAPTER 4

Costs and Benefits

General Benefits

People value forests because they produce goods and services. Material products such as wood, bark, fruits, resins are termed as goods. It is noted here that many of these commodities are not rightly exploited in the present state of technology.

With the exploitation of wood in three different types—cutting to shape, gluing it and protecting it from rot or other damage—the full potentialities of the peculiar internal structure of wood have not been harnessed as yet. For example, polymerization of methyle methacrylate in situ provides a new process to stabilize wood¹. Technology is still relatively primitive and in its infancy in respect of chemical utilization of forest products. Research is definitely required for discovering new and more efficient uses of woods. It seems that the second type of benefits—services—have been regarded as more important than physical products of the forests under many situations. For example, the forests are not removed from the tops of the mountains for fear of soil erosion. With the introduction of other methods of engineering and land management such purely physical influences may decline.

In any investment appraisal, the costs and benefits are matched against each other, to see whether the net benefits add up to give the required return on investment. This type of benefits that results from a project would depend upon the nature of the project, but broadly, the net gain is either savings in cost of additional revenue or a combination of both.

Cost Benefit Analysis

The main function of cost benefit analysis is to appraise the economic effects of a given project activity in the widest terms. Cost benefit analysis measures these effects in money

¹Forest Prod. Res. Report for 1964-65 in Britain (13-14).

terms as far as this is possible. Cost benefit analysis does not restrict its field to marketable goods alone. It can bring both marketable and unmarketable goods and services into its fold. This method identifies that cost of all those inputs needed for production of goods and services and benefits from outputs provided. The analysis aims to correct for any distortions prevailing in the market. It also tries to assess unpriced benefits such as environmental effects.

Cost benefit analysis is essentially a tool of economic planning for use in circumstances where a public authority seeks to make a normative judgement relating to a course of economic action. Cost benefit analysis may be indeed regarded as an essential component of the social framework. While it is recognised that public decision-making is mainly a matter of political consideration, resource allocation should not be left to uniformed political pressure.

Cost benefit study indicates if the benefits from a particular activity exceed the cost, if so, by how much. But it has nothing to do with the income distribution effects of a project. For example, a factory owner may earn Rs. 20,000 at the expense of the poor who lose Rs. 10,000, the net result being an overall gain of Rs. 10,000, but decision on whether this is desirable is a political rather than an economic matter.

Cost benefit analysis is coming to be applied to forestry. Forestry activities are undertaken in regions with poor employment and often poorer income opportunities than those available in urban areas. Here the opportunity cost of labour may be a fraction of the market wage. Cost benefit analysis has recently been used to study the effects of afforestation in the regions of Great Britain where depopulation is regarded as undesirable.

Among developing countries, India is leading in the use of cost benefit analysis where it has been considered proper in the context of planned development. But even there, its use has been limited to analyses of nuclear power research, family planning programmes, road transport undertakings, irrigation projects, industrial enterprises and few other activities. It has

not yet been applied to forestry activities as it has recently been in Britain. It is because it needs a continuous flow of data while forestry in India lags behind in respect of forestry data. However, it is a demanding exercise and hardly practicable at all levels of an enterprise. It has, therefore, not been possible to attempt the cost benefit analysis of forest resources as outlined above. However, the analysis of the benefits flowing and the cost of inputs in forestry have been analysed with the help of demand and supply analysis.

Economic Benefit and Costs

There can be different methods of evaluating costs and benefits in respect of forestry. There are two types of costs and benefits. The first type of benefits can be measured in terms of money because the commodity in question is saleable in the market, for example, the sales proceeds of timber, fees collected from the graziers and dues from rightholders. The second type of costs and benefits are those to which values are imputed, viz., provision of employment, production of raw materials on which depends the establishment of forest-based industries. With the above facts in view, it is easy to evaluate the forest products.

Value of Forest Products

Here the discussion focuses on the central theme how the market price of wood and wood products stabilises. The principles used in this analysis are usually very common to understand the price fixation for any product, but there are some special reasons why wood products need particular attention. In the ordinary business of life the prices of wood products, logs and standing trees are determined by the intersections of the economic forces of demand and supply. These economic situations are not allowed to have free play of the forces of demand and supply by controlling certain prices. For example sawn-wood continued to remain under control in New Zealand. The same situation prevails at the time when certain institutional arrangements are made to enable the operation of imperfect competition. Many forest departments find it most convenient to sell their wood on the basis of fixed royalty settled

for a number of years. In this respect large wood using industries exploit their bargaining power to bring down the prices of wood, required for processing, where competition is limited due to the presence of one or only a few firms in the market. For example the Forest Department, Madhya Pradesh leased out large bamboo bearing tracts to M/s. Dalmia Paper Mills at a nominal royalty of Rs. 10 per tonne for the manufacture of paper.

Overlooking these imperfect conditions prevailing in almost every country for every type of wood and wood product in a market, it is possible to provide a rough and ready analysis for supply and demand conditions and also the conditions to arrive at some useful conclusions about the future trends in quantities and prices of goods to be sold and bought.

A number of countries have successfully conducted timber trend studies of one kind or another at different periods. Since the war, the Food and Agriculture Organisation of the United Nations has been busy in reviewing and estimating likely changes which may occur in consumption pattern, production and trade of forest products in future. It is estimated that international trade deals with about 20 per cent by value of wood output of forest products. Such studies must take into account all technological changes, economic and institutional.

Relationship between Demand and Supply and its Effect on Price

The relativity of wants has a number of important implications. In the first instance, it directly effects the priority in the allocation of resources. It is quite normal that satisfaction of one want leads to other wants. Employment is generated in the process of satisfaction of wants. Secondly, it is important to note that the complete satisfaction of all wants is not possible. Wants are innumerable but despite this fact, economic theory proceeds largely on the assumption that wants are more or less fixed. The demand itself is dependent on the availability of resources, characteristics of the goods and the limitation of supplies.

The demand for any commodity or service may be a composite one. As such the demand may be compounded

out of a number of different uses; viz. the scantlings for making planks or coniferous soft wood for manufacturing pulp etc. A product may be demanded jointly with some other products; e.g. the wooden handle and the blade of a knife are demanded jointly or the ink bottle and ink. The demand for a commodity or service may be derived from the demand for some final good; e.g. the demand for carpenters' labour is derived from the demand for house building.

Consumers demand for final products is the ultimate source of the derived demand for resources. However, the demand of dealers and the demand of the final consumers can vary independently in the short run. The demand of the dealers may possibly be influenced and affected by future prices.

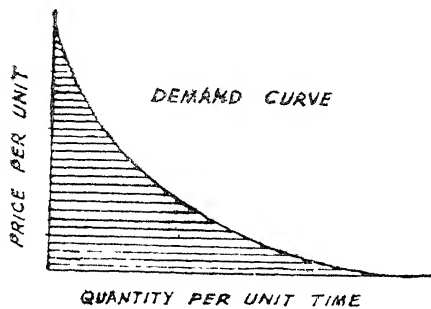


FIG. 1

However, this factor has little importance in determining consumers demand. The day-to-day fluctuations have little relevance with the demand and supply curves in this type of market. The tools of demand and supply are useful concepts if two forces affecting demand and supply are largely distinct from each other. But in the case of determination of the price of forest product, this is quite different. For example, the case of consumers differs altogether from producers. An examination reveals that there are two different sets of people—the creators of demand in this case. However, in a traders' market, both the functions—of buyers and suppliers—are carried out by the same set of people. They usually shift from one side of

the market to the other. Therefore, the function of demand and supply is not fully carried out in this case.

If the demand curve is conceived of as a boundary line, under a given set of circumstances, a point on the demand curve shows the maximum quantity that the purchasers would like to purchase at a fixed price per unit time. Generally the demand curve supposes that buyers are free to buy either the indicated or smaller quantity at the announced price. The quantity to be purchased is to remain within a certain limit. The purchasers are faced with a unique situation under a different demand curve, e.g. an "all or none" decision. In this

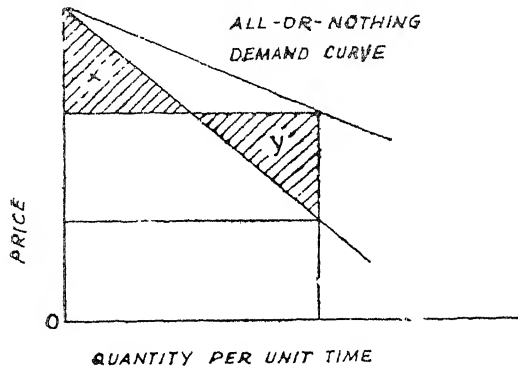


FIG. 2

situation the purchasers have the option of either to buy the whole quantity offered for sale or nothing at all. Generally as "all or none" demand curve would occur on the right of the usual demand curve. Such curve will especially be determined when the two cross-hatched areas X and Y are equal. The above condition puts its external limit on the boundary but in a general way it is expected to occur in between the usual demand curve and the external limit of this curve. The "all or nothing" demand curve is specially useful for analysing certain problems. But here we are to consider the general demand curve shown under figure 1.

Time factor plays different roles in the demand curve. First of all, the horizontal axis measures quantity per unit of

time, e.g. wood for railway bogies per month or per year. The purchaser can draw a continuous curve with the use of time even for items such as harmoniums or shop buildings involving discrete amounts in the purchases. Secondly there are different points on demand curve which should be considered as alternatives as of a moment in time. The maximum quantities which the purchasers are willing to buy at different prices are shown on the demand curve. Here "time" is as a synonym for "under the given conditions". Thirdly, there is use of time for adjusting the period for drawing the demand curve, which facilitates analysing the effects of changes in supply. In the shortest of all runs, where conditions do not change very much the demand curve is expected to be the least elastic. The elasticity of demand curve tends to increase with the change in conditions. The following figure depicts these changes.

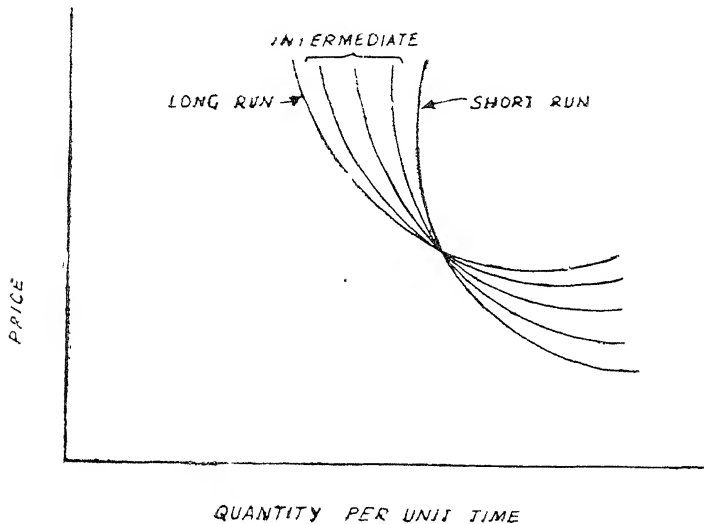


FIG 3

The Concept of Supply

The supply side can be analysed by distinguishing between supply schedule and quantity supplied, just as it is in the case of demand curve. Generally the supply schedule shows the

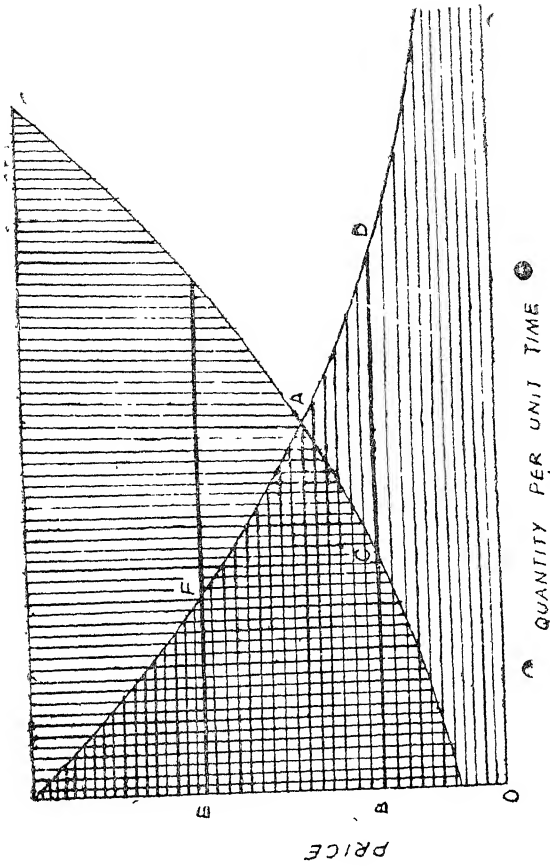


FIG. 4

the buyers would like to buy EF and the suppliers to sell FG. Now the problem arises for rationing supplies where FG measures the size of the problem.

Two examples may serve to illustrate the usefulness of these concepts. Consider the present condition of newsprint in India. The Nepa newsprint factory is not able to meet the demand of newsprint as production of newsprint in India covers only fraction of the total consumption. In this case the Government has limited the use of paper e.g. more than a certain quantity of newsprint cannot be used to make a newspaper. On the other hand the readers want newspaper even on an enhanced price. Since the stock is limited the price of newspaper is increasing day by day. But since it is a controlled item the forces of demand and supply cannot play so forceful a role as they do in a free competition market. Since newsprint is in short supply some editions of popular papers had been closed down for publication or some papers did not bring out their editions on a particular day for sometime e.g. Hindustan Times and Times of India on Monday. The price of newspapers must have gone quite high had these not been controlled items. The import of pulp for newsprint is becoming difficult proposition in two ways e.g. (i) shortage of foreign exchange which is badly required for other developmental activities, (ii) the newsprint pulp is not easily available in the world market.

Similarly take the case of constructional wood. Good constructional wood is not available in large quantities so as to satisfy the demand of everybody. Therefore its price is rising to some high levels. In this case two phenomena come to light e.g. (i) exorbitant rise in price and (ii) use of less valuable woods after preservative treatment. The second phenomenon tried to bring down the price of wood to some extent. This is represented in the figure overleaf. If the underlying forces of supply and demand had been allowed free play, then the equilibrium quantity would have been OE at an equilibrium price OC. With a nominal list price of OA the quantity supplied was OB but consumers were willing to pay OD for this quantity OB. Therefore people adopted various under hand methods to pay this price. This price OD is above the equilibrium price

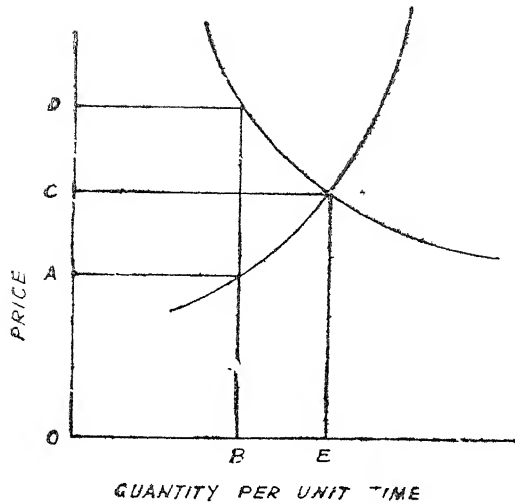


FIG. 5

OC and the quantity OE which would have been supplied at the price OC. If free competition is allowed to play its role the price will finally settle down at OC for the supply OE.

The concept of an equilibrium price has been depicted in the above analysis. An equilibrium position is one which can be maintained on its attainment. There are three types of equilibriums, e.g. stable, meta-stable and unstable. The stability of equilibrium can be judged by the fact that it has a tendency to move back to its original position after some displacement. For example, if for a negatively sloped supply curve and positively sloped demand curve, price should fall below the equilibrium price, the quantity supplied will fall short of the quantity demanded. This action will set forces in motion that will drive down the price to its original equilibrium level. The meta-stable equilibrium is that state from where there is no further movement after any displacement. This would happen only if the demand and supply curves were coincident. The unstable equilibrium is that when an original displacement of supply and demand sets up forces again to lead forces to create

further displacement. The third case comes into operation if a price rise for any commodity creates a higher demand for the commodity, thus the quantity supplied falls short of demand. This fact causes the price to drive away even further.

Effect of Shifts in Supply and Demand on Equilibrium Price and Quantity

Equilibrium of price and quantity changes with the shift in either or both curves. This point is illustrated in the following figure.

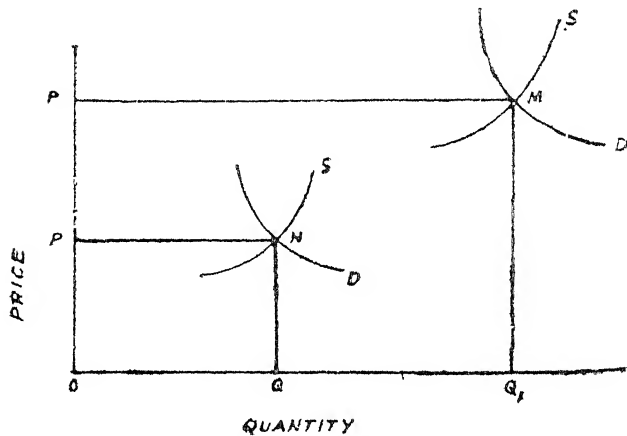


FIG 6

When demand curve shifts from D to D_1 it shows that more consumers are ready to purchase at a given price or in other words the same quantity may be demanded at a higher price than before. Similarly the supply curve goes from S to S_1 owing to shift in supply. It means the same price will call forth a higher level of output. Alternatively the same quantity will call forth a higher level of price. Point N indicates the equilibrium position in the first state and M shows the equilibrium position in the second position. The example shows the shift in demand to be greater than the shift in supply. Thus both price and quantity in the new position are higher than in

the old situation. If supply expands faster than demand, a higher quantity is expected to be exchanged at a lower price than before.

The knowledge of the following facts is necessary in order to analyse and forecast changes in quantity and price.

(a) All the expected changes in demand in the major consuming countries.

(b) Every expected change in supply at least in major producing countries.

(c) The expectation of trade among different countries.

The demand under one period can be related to demand in an earlier period. For example, licensing of wood during war time leads to economies in the frugal its use. The interdependence of demand over time is as important as the interdependence of supply. The overfelling in forestry during war time inflated the supplies but such supplies were limited in the post-war era when felling could not be continued on the same scale, in order to conserve the forest resources. Hence the supply became more stringent. The same argument can be applied in opposite direction. Felling of over-mature trees which shows no net increment because growth is in balance with loss through death and decay can lead to a sustained rise in production.

Concept of Derived Demand

When one speaks of the demand for lumber or for paper, it is generally understood by people. The demand for lumber, paper and plywood is not direct but a derived one from the sale of finished goods like furniture, newspapers, books and carrom boards etc.

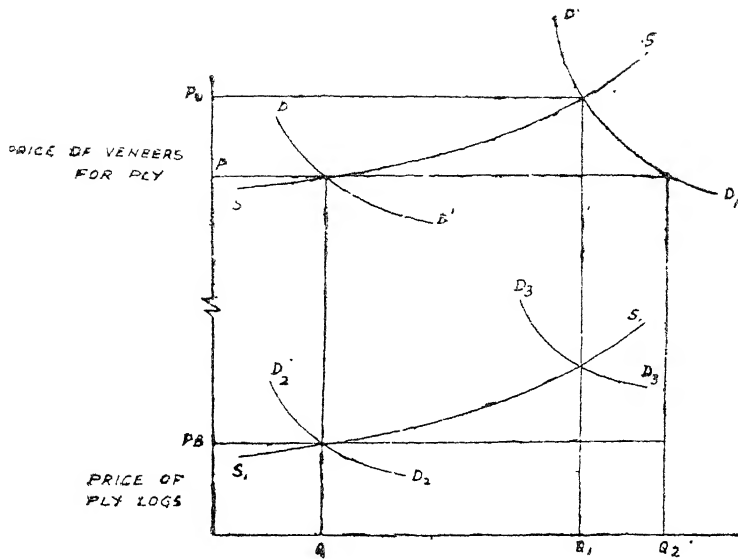
Let us take the case of ply logs. Some writers think that the demand for ply logs is inelastic¹, because there is virtually no substitute for them in manufacturing timber. The species and quality are important factors in the demand for any specific timber stand. The position does not change much even if the

¹Mead, J.W. 1966 Competition and oligopsony in the Douglas fir lumber industry, Berkley University of California Press.

demand for logs may arise from paper and plywood or lumber. An owner of a sawmill produces some sawnwood with the help of some inputs such as saw logs, or sawyers for which he pays a price with an expectation to earn revenue out of its sale. The production needs some other materials like machinery, services of manual workers along with these inputs. Other factors of production which are employed jointly do play their part in deciding the market price of the factor of production. The producer will try to substitute machinery for labour, if he finds wages have gone up. Thus the price rise will definitely affect employment. Further, if wages rise the cost of production rises irrespective of substitution of manpower by machines. The consumption of such a produce is likely to fall if its demand is inelastic. This will affect the employment of labour and other factors of production in a particular industry.

The following illustration clarifies the concept of derived demand. Suppose sawn softwood is needed in a market. This creates demand for softwood sawlogs. A shift is assumed in the demand for sawnwood, while the foresters are willing to harvest enhanced quantities of wood at various prices and the milling capacity remain unchanged.

The line DD^1 represents the relationship between demand and price of ply veneers and $D_1D_1^1$ represents a changed demand in year 2. Point P represents the market equilibrium in year 1 at which Q is produced and sold. Since millers agree to produce and sell at this price the same quantity which the consumers of plywood are willing to buy. Above are depicted the related curves—supply and demand for plylogs and plywood. D_2D_2 represents demand for round logs, S_1 represents the quantities of wood which foresters are willing to supply at various prices. PB_1 represents the volume of plylogs supplied by forest contractors for sale to the millers. Consequential to this P shows equilibrium in the market for plywood with Q. The demand for ply veneers is reflected in the changed demand for plylogs without any change in the supply of plylogs, log price rises from PB_1 to the new point of intersection of S_1 with D_3 . The quantity settles down at Q_1 . If price elasticity of supply of logs is very high than that of ply veneers, the relative changes are likely to occur in both plylogs and ply veneers.



Volume in Cubic Metres of Plywood (Veneers) or Roundwood Equivalent of Ply Veneers

Fig. 7 Effect on price and quantities of ply (veneers) and plylogs of a (Veneers)

If the price of plylogs rises by 10 per cent from Rs. 30 to Rs. 33 per cubic metre, and peeling costs were to remain unchanged, the result of competition among millers would be to raise the price of plylogs by the equivalent absolute amount of Rs 3 per cubic metre of ply veneers outturn.

The above analysis does not take into account dynamic elements which are likely to enter the situation to obscure the consequences described above. It is possible to arrive at a new stable equilibrium position, but it may also be unstable. In this process the rate of adjustment of price and quantity will differ from one market to another. For example, an equilibrium which may be stable or unstable is provided by the production of agricultural crop—say sugarcane—the demand for which remains unchanged through years. Farmers usually base cropping pattern for the coming season on the basis of price

obtained in the current year. If the prevailing price is high the farmers are induced to grow more in an area of a particular crop to get high yield next year. Since the demand for the product is unchanged next year, the increased supply forces the price to fall. The low price in turn makes the farmers refrain from growing more by reducing the acreage the following year. This action reduces the supply and helps the price to rise to its new heights. Thus the whole cycle¹ then starts anew. Here it is noteworthy that price can be very effective signal to producers to alter their production plans, at the same time it indicates the inefficient allocation of resources. In one year a glut means the wasting of resources, in another a shortage means that consumer wants remain unsatisfied.

A parallel example is provided by the creation of eucalyptus plantations in Uttar Pradesh which are not finding their proper use for the manufacture of pulp. The forester refrains from creating of such plantations, though these plantations may ultimately not go waste but find another use. At least some material has been created, but it is not serving the purpose for which it was created originally. One thing is noticeable in forestry, that relative prices cannot remain unaltered for 50 or 100 years ahead.

The foregoing examples clarify the interactions of economic forces. Particularly, the prices of factors of production and of products are greatly diverse. This fact makes the task of production more difficult.

The Analysis of Demand

Variations in income or purchasing power of individual buyers, of potential buyers, are likely to affect changes in demand for a given commodity, or commodities. The change may be affected owing to the preference of the buyers or the price variation of the commodity or the availability of the commodity or its substitute. The relationship among consumption, income and price can be assessed from studies of time series based on either annual or monthly data where the underlying preferences

¹This process is known as "cobweb" in economics because of the pattern traced out by successive changes in volume of output and market price.

are assumed to be unchanged. The changes in demand occur on account of changes in the yearly values of income and price and also on account of cross-sectional studies showing variations in demand by different sections of the population of a country.

The Demand for Wood in India

A study of the annual data on consumption of industrial wood regressed on two variables—Gross Domestic Product at 1960-61 prices and the percentage contribution of the forestry and logging industry to GDP (at 1960-61 prices) for the period 1960-61 to 1969-70 indicates that variation in the variable consumption of industrial wood—can be accounted for by the two measures of final demand—the GDP and the stock-building during the course of the year.

But in case of fuel wood, the regression equation implies that only 21 per cent of the variation in the variable—consumption of fuel wood—is explained by the two variables—the GDP and the percentage contribution of forestry and logging to the GDP is stock-building during the course of the year. This is but obvious for fuel wood in a developing economy like India. This is shown by regression equations belows.

Table 5 Regression equatons in Respect of Industrial Wood and Fuelwood.

	Regression Equations	R ²
Industrial Wood	$Y = 55.5 - 0.00007X_1 - 14.2X_2$	0.9793
Fuel Wood	$Y = 121.3 - 0.0005X_1 - 4.3X_2$	0.2097

More specific relationships dealing with demand for particular categories of wood will better help forestry planner while the income relations are more directly useful in national economic planning.

The Analysis of Supply

Demand is one of the two blade of the scissors of demand and supply. The analysis of economic forces that combine to determine equilibrium prices and quantities produced and consumed, is incomplete without necessary discovery of the relations between production and the prices at which different

levels of production are sold. The relationship between prices and the quantity which producers are willing to produce and sell is known as the supply schedule. Here the meaning of supply is not limited to the volume of output alone as it is usually understood by production of forests or forest industries but it also correlates the relationship with price. The supply schedule when put on a graph usually shows an upward inclination. For example, the supply schedule in the sawmilling industry at a given time at which the structure of the industry, might be as follows :—

Table 6. Hypothetical Supply Schedule for Plywood

Price per cubic metre, Rupees	600	700	800	900	1000	1100	1200
Quantity that sellers will supply, million cubic metres per year.	7	8	9	10	11	12	13

When the price of plywood is high, millers do buy more logs inclusive of low quality which would not otherwise be able to be utilised and to pay more wages and other operating costs. In the short-run these people may not be able to establish more milling machinery. In this case their output will be limited to the existing capacity of sawing machines and other physical limitations. In the long run, viz. several years when the millers expect the high prices to persist, they may invest in creating additional capacity of the mills. However, it is clear, that in the course of a year at a given market price, the millers who have the lowest costs of production will have a tendency to earn extra profits. The millers whose cost of producing the last cubic metre of plywood (the marginal cost) is close to the current market price will earn relatively small profits. Thus the producers will go on producing so long as price just exceeds the marginal cost of production in the most expensive mill. Costs, in the long-run, have a tendency to determine price since all the various factors of production remain unpaid, firms will gradually go out of production.

The relationship for supply of standing timber is altogether different. The supply price at which the forest officer is willing

to sell the last 100 cubic metres will not be decided by the relationship of its cost of growing, but rather by the subjective view of what the owner considers a sufficiently attractive price in relation to his particular economic circumstances. If the price of harvested trees in a particular region which result from derived demand for logs and the supply of logged trees is Rs. 1,000 per cubic metre, and the cost of harvesting in the most expensive situation is Rs. 500, the market price for stumpage will be Rs. 750. The Forest Officers will sell timber at this price regardless of whether it has cost Rs. 500 or Rs. 1,500 per cubic metre to grow. The investors will be less willing to invest their capital in managed forests unless they expect a reasonable return on cost in the long-run. Therefore, in the more distant future, stumpage price may tend to reflect the costs incurred in growing it.

Both the institutional and economic factors govern the supply position of roundwood. True it is that harvesting will only be taken up if price paid for logs cover the costs of harvesting, but under certain circumstances cutting may be done for silvicultural reasons. Of course, such reasons must command some sound economic reasons. For example, uneconomic felling or clear felling, may be undertaken in case it is expected to improve the profitability of a crop in the long run.

CHAPTER 5

Economics of Consumption

Total consumption of a nation comprises consumption of all individual members of the community. The sum-total of the amounts—leaving aside the individuals—spent on consumption in the amount spent by the community as a whole. Though it looks odd but individual decisions to consume are important. Therefore, it is necessary to find out how individuals decide to consume. As a result of these decisions we know the consumption of the community. According to Keynes we take it for granted that consumption has a fairly stable functional dependence on income as in price theory the amount demanded clearly depicts a functional dependence on price. Therefore there is a definite relationship between the income of a consumer and the amount he spends on consumption. For example, if for a consumer C stands for consumption and Y stands for income, and F stands for functional relationship between income and consumption. Therefore it can be put as $C=F(Y)$. In other words F denotes the 'propensity to consume'. Therefore if one wishes to know how much one would consume out of his income on a particular item, if his 'propensity to consume' is to be known. Therefore there is a clear need to generalise the 'propensity to consume'.

What is the general relationship between income and consumption? In this connection it will be better to think about the size of income and all other factors affecting consumption.

An individual's propensity to consume in a community depends on the factors, viz., (i) his subjective attitude towards consumption and (ii) his objective data about community. What are these objective conditions which determine his 'propensity to consume'? Price is the main objective fact other than money income. Price is supremely important in respect of consumption of individual commodity. The con-

sumption of a certain commodity depends on the changes in consumption.

Consumption

Price but price is less important when the consumption of all goods is considered. Though it is true that a substantial rise or fall in all prices will be an important contribution as it will change the real income greatly. It gives rise to the development to a relatively simple theory assuming that the price is constant.

There is alteration in the demand for all consumption goods in the long-run if the tastes of the consumers are changed, but in short-run such changes are unable to affect the demand. The consumption of people changes due to capital losses or gains, but it cannot be advocated what the effect is. Therefore it is doubtful if such changes can prove otherwise. Changes in fiscal policy—taxation mainly—are more important, but to simplify matters these are not considered here. However, it is felt that the level of prices is an important, objective factor to cause fluctuations in the propensity to consume. Rate of interest—an objective factor—should also be considered. The rise in the rate of interest curbs the ‘propensity to consume’ and vice-versa. Many economists assumed until recently that if the rate of interest rose, people would have a ‘propensity to save’ more and consume less; just it is reverse when it fell. Though this statement sounds well but Keynes assumed that the direct effect of the rate of interest on consumption is negligible.

It is normally correct but not certain to assume that a fall in the rate of interest will increase consumption and vice-versa in the case of an individual. Suppose a consumer saves Rs. 1,000 per annum, after paying the taxes etc. on his income, and he invests this hard earned money in Government securities to receive Rs. 600 per year from his investment at 6 per cent. He has to purchase securities worth Rs. 10,000 only. But if the rate of interest rises to 12 per cent, he will have an income of Rs. 1,200 per year. Since he feels satisfied with Rs. 600 per year, he will save Rs. 5,000 only instead of Rs. 10,000. This

shows a marked effect of rate of interest but some people may save more than the others. It may not affect the community as a whole. On the other hand the quantity of saving and spending of the people are quite independent of rate of interest. There is no connection between the rate of interest and the rainy days. Therefore, the rate of interest does not affect the 'propensity to consume' directly.

The above discussion shows that the changes in income have a direct bearing to affect a person's 'propensity to consume'.

Subjective changes occur in the long-run and they are quite unimportant in the short-run. Keynes was more realistic than 'bread tomorrow and the bread today'. Keynes maintained that saving may be motivated by the feelings of pride. One may wish to have enough riches to hold his head high in the society, or he may have an instinct to overcome unforeseen difficulties as illness or unemployment. Keynes opines that all these subjective motives may be unable to reduce consumption. Instead they may well increase it. An extravagant or a careless person may waste his money and a generous man may give it away.

The aggregate expenditure on consumers' goods in the economy is the sum of the expenditures of the individual households. The amount of consumption depends first of all on his income after deducting the taxes etc., viz. disposable income. If every household spent all of its disposable income on consumption, the aggregate expenditure on consumers' goods would vary directly with the aggregate disposable income. But in case the individual decides to save some part of his income and aggregate consumption expenditure may be less than the aggregate disposable income. Generally speaking the higher the income of an individual the greater is the amount which he is likely to save rather than to spend it on consumption. The relationship between the amount of individual's income and the amount spent on consumption is known as the 'propensity to consume'. Some results of investigations reveal that in the long-run, the individual's average 'propensity to consume' remains unchanged owing to increase in his income. Therefore,

he has a natural instinct to saving more money out of his enhanced income. As the income rises high the gap between the amount he saves and the amount he spends on consumption widens.

Since the aggregate income of a whole economy is the sum total of the income of the households in the economy, the increase in national income is likely to show a growing gap between the total income and the amount spent on consumers' goods. As a result some part of the circular flow of income in the economy has a tendency to be drawn towards savings instead of it being spent on consumers' goods. In this way the economy loses its equilibrium unless these savings find their way back again into the circular flow of the economy. Most of the savings find their way back into the circular flow of the economy as the average individual has no tendency to hoard his savings. Either he spends these savings for buying producers' goods for himself or he lends these to someone else who uses them for that purpose. Therefore the money thus spent becomes a part of the income flow. But even then 100 per cent savings do not come forward for investment and some part of it still remains hoarded. This gives rise to unemployment of resources. It is true that the portion of income realised by government as taxes usually find its way immediately to the aggregate income flow in the form of government expenditure.

There are two factors which control the 'propensity to consume' of a family, viz. (i) its income and (ii) the level of income and of consumption of its neighbours. The tendency to spend on consumption owing to increase in income increases, but not proportionately. This was found by Engel in Germany in the 19th Century from his study of family budgets. Keynes called it as the "consumption-function".

It is also true that the consumption pattern of one family depends upon the levels of income as well as the consumption patterns of other people living in the locality. If one family in a locality gets a refrigerator, other families will try to acquire it soon. If one family has a T.V. set, others too would like to have one as soon as possible. This is true in case of cars, radios, transisters, better clothes and better education facilities

etc. Thus there is a tendency among people to imitate others. This is known as the demonstration effect. According to Ragner Nurkse "when people come into contact with superior patterns of consumption with new articles or new way of meeting old wants, they are apt to feel after a while certain restlessness and dissatisfaction. New desires are aroused among people when their knowledge is extended and their imagination is stimulated". This gives rise to the 'propensity to consume' to shift upward¹. As James Duessenbery, the famous American economist popularised this concept, it is also known as the Duessenbery effect. It may be defined as the tendency among people to imitate the superior consumption habits of others and the consequent upward shift in the consumption of people.

Actual and Potential Demonstration Effect on Consumption

Demonstration effect on consumption can be actual or potential. Suppose a family—Mamchand's—has a monthly income of Rs. 800 per month while the average monthly income of all other families living in the locality is Rs. 1,500. Mamchand's family will generally try to purchase those goods which the well-to-do families possess as Mrs. Mamchand would not like to be let down before the neighbours. For this reason Mr. Mamchand will be compelled to spend more than what he would normally spend. This is known as actual demonstration effect. Because of the low income, Mr. Mamchand's family is not able to imitate the superior standards of the rich families of the locality. If per chance the income of the family rises, the additional income is liable to be spent on consumption rather than on saving. This is known as potential demonstration.

Demonstration Effect and the Level of Saving

Saving is that part of income which is not consumed. If additional income is assumed to be 1 , and additional consumption to be dc and additional savings to be ds , then $dc - ds = 1$ or $ds = 1(-) dc$. Every increase in the 'propensity to consume' under the influence of the demonstration effect is the decline

¹Nurkse: Capital Formation in Underdeveloped Countries, pp 58-59.

in the 'propensity to save' and vice-versa. If there is no change in the 'propensity to consume' the marginal 'propensity to save' is zero. There is possibility of such cases in low income groups trying to imitate the higher income groups. The greater the inequality among people the stronger is the demonstration effect on consumption. In case of lower economics having a vast difference between rich and poor, the demonstration effect will be much more powerful bringing down the level of savings very low. For instance 75 per cent families in U.S.A. do not save anything as they spend everything they earn on consumption because the standard of living and consumption pattern of the rest 25 per cent of the families is so high. In 1917-18 it was estimated that an average urban family with an income of \$ 1,500 (1941 prices) saved 8 per cent of its income, but in 1961 it saved nothing while there was no change in income pattern. The conclusion is that the level of saving and capital formation will depend upon the demonstration effect on consumption. The stronger the demonstration effect on consumption, the lower will be the level of savings in the economy.

Consumption of Forest Products and Savings

The economic function of forestry hinges on production of goods and services which are finally required to satisfy human wants. There is a broad variety of desires to be satisfied since forest is an extremely versatile. Forest products fall generally into the following groups :—

1. Wood products.
2. Animal products such as fur, horns, bones and game.
3. Water.
4. Recreation.
5. Protection.

People of some locality may have specific value for one of these goods and services, but wood seems to be the most important product of the forests for our national economy. Therefore a major part of this discussion will be devoted to wood. Water is perhaps the second important item of consumption for the people in the country. And recreation covers the third

place in importance. It is not possible to discuss these items thoroughly according to their importance in the absence of proper research on the economics of these products. The other products listed are of little importance in our economy. Though protection functions of forests are important but our knowledge to weigh them in economic terminology is somewhat restricted in this respect.

Forestry concerns with dual types of demand: (1) direct demand created by ultimate consumers and (2) derived demand created by intermediate producers of forestry goods. There are few physical products of the forest commanding a minor importance, which become consumers' goods. Such goods are produced because there exists an ultimate consumer demand for goods or services. Forest products are utilised for production of such goods. Now let us try to see how the demand for forestry products stems from the desires of ultimate consumers. But this fact cannot be studied alone as forestry is indirectly tied to the rest of the economy in so many different ways that we do not find ourselves secluded from all the economic activities of the people.

Consumption of Wood Products

Present consumption of wood products seems to be a logical starting point for analysing the demand pattern. Following table shows the consumption of wood in India in 1969-70.

Table 7. Production of Wood—1969-70

('000 cubic metres)

Description	States		U. Ts.		Total	
	Coni.	Non-Total Coni.	Coni.	Non-Total Coni.	Coni.	Non-Total Coni.
1. <i>Industrial Wood</i>						
Saw logs,						
Veneer logs						
and logs for						
sleepers	1258	4864	6122	— 170 170	1258	5034 6292

2. Pulpwood and Pitprops	—	935	935	—	16	16	—	951	951
3. <i>Industrial Wood</i>									
Other Industrial Wood not exactly specified	39	1633	1672	—	2	2	39	1635	1674
Total	1297	7432	8729	—	188	188	1297	7629	8917
4. Fuel Wood (including wood for charcoal)	460	12205	12665	—	116	116	460	12321	12781
Grand Total	1757	19637	21394	—	304	304	1757	19941	21698

The following table shows the production of wood—Industrial and Fuel—statewise :—

Table 8.¹ Production of wood—1973-74—statewise

States/U.Ts.	('000 Cubic metres) ^r		
	Industrial Wood	Fuel Wood	Total
1.	2.	3.	4.
1. Andhra Pradesh	287	547	834
2. Assam	402	105	507
3. Bihar	376	314	690
4. Gujarat	136	237	373
5. Haryana	33	84	177
6. Himachal Pradesh	459	175	634
7. Jammu & Kashmir	341	71	412
8. Karnataka	1,055	1,482	2,537
9. Kerala	565	872	1,437
10. Madhya Pradesh	1,449	1,779	3,228
11. Maharashtra	377	1,913	2,290
12. Manipur	11	14	25

¹Forestry in India—1973-74—Summary Tables—Directorats of Economics and Statistics, Ministry of Agriculture and Irrigation, Government of India—1977.

13. Meghalaya	43	1	44
14. Nagaland	9	12	21
15. Orissa	1,700	3,503	5,203
16. Punjab	50	41	91
17. Rajasthan	9	195	204
18. Sikkim	—	—	—
19. Tamil Nadu	31	320	351
20. Tripura	33	35	68
21. Uttar Pradesh	1,124	2,564	3,688
22. West Bengal	337	700	1,037
Union Territories			
1. Andaman & Nicobar	122	15	137
2. Arunachal Pradesh	160	67	227
3. Chandigarh	—	—	—
4. Dadra & Nagar Haveli	—	—	—
5. Delhi	—	(a)	(a)
6. Goa, Daman & Diu	16	163	179
7. Lakshadweep	—	—	—
8. Mizoram	—	—	—
9. Pondicherry	—	—	—
Total	9,125	15,209	24,334

Above table clearly shows the outstanding importance of lumber as a forest product. Fuelwood ranks first in order of merit in terms of actual volumes of wood consumed in India. This is the predominant use of wood in India. What to say of India it is so in the world economy. If fuel wood consumption is taken as a whole in India, viz. recorded and unrecorded, it goes without saying that about 90 per cent of the wood is used as fuelwood and thus the whole wood economy of India is shattered. Fuelwood is the only significant wooden consumer good produced directly from the forest. Secondly the bulk of fuel is used in the rural areas which does not add to the transport problems in India since most of the fuel from unrecorded source is produced and consumed locally. Second in importance is the production of Industrial. Unlike fuelwood industrial wood is produced from recorded sources only. The final consumer demand which lies behind the wood going into industrial

(a) Below 500 cubic metres.

products is rather complex. Therefore it becomes necessary to trace each major wood product from primary producer to ultimate consumer. No complete and detailed study of demand for wood has been made in the country so far.

Forestry is a primary production sector from where different products are processed in one or more stages before they are finally consumed. The consumption can be assessed in two different ways, viz. (i) from recorded sources of origin in the forests, or (ii) by working back from the finished products consumed in the market. Production of timber and logs can be assessed from recorded sources, whereas the requirements for pulp and paper could be worked back from the production of recognised industries. Substantial production may however escape accounting as a large quantity is utilised near the sources of production without finding place in any of the recording systems. Wood and other forest products are not produced in the forests alone. Large quantities are produced outside the forestry sector on farm lands and wastelands. All these have to be accounted for to find out the full consumption of the forest products.

The 'estimated requirement' is used to mean the amount of a product that would be consumed by the population of the specific size receiving the assumed per capita income with an assumption that wood products are supplied at the same related prices and under the same quantitative restrictions of consumption which exist during the base period. Another assumption is that total future requirements from 1980 onwards would be met from indigenous resources.

The population has been estimated as 680 million in 1980 and 800 million in 1990 and per capita gross domestic product at Rs. 670 and Rs. 990 respectively. The estimate of wood product consumption in 1980 and 1990 have been based on the following assumed income elasticities adopted from the F.A.O. study for the region with suitable modifications : ¹

Sawnwood	0.8
Plywood	2.0

¹National Commission on Agriculture, New Delhi

Particle board and fibre boards	1.0
Newsprint & writing & printing paper	2.0
Industrial paper	2.5
Absorbing tissues	3.0
Roundwood	0.5

The consumption and the projected demand for different forest raw material are set out in the following paragraphs. The shift in utilisation patterns, affecting the income elasticity of the respective projections from solid wood to processed wood and panel products would apply by and large to urban areas in India. In rural areas where very little sawnwood is utilised owing to low income of the populace who live in huts or roofs constructed with leaves and other material, shift in utilisation pattern will not matter much. The consumption of sawnwood is expected to go up quite substantially on account of increase in agricultural income. This is reflected very much in the regional study for Andhra Pradesh conducted by the Pre-Investment Survey of Forest Resources (PIS). Since rural populace comprise 80 per cent in the country, this will influence an upward trend in the pattern of consumption and thus the requirements of sawnwood will be higher than before.

Based on the above consideration, the consumption and the projected requirements of the raw material for sawnwood will be as follows :—

Table 9. Consumption and Projected Requirement of Raw material for sawnwood.

Category	(‘000 m ³ in the round)		
	Consumption 1970	1980	Demand 1990
<i>Sawn Wood</i>			
(i) Coniferous	1,265	1,760	2,445
(ii) Hardwood	7,898	11,005	15,060
Railway Sleepers	398	190	140
Total	9,561	12,955	17,645

Panel Products

This product does not find mention in the existing forest statistics from the states. Data for this purpose are therefore, collected separately from the user end in the plywood and veneering industry and industries producing other panel products. There is little possibility of misleading reporting as the production of these materials mostly comes from well recognised sources. Following table shows the wood requirement for Panel Products :—

Table 10. Wood Requirement for Panel Products
(‘000 m³ in the round)

Year	Quantity
1970	371
1980	956
1990	1463

Pulp and Paper—Pattern of Utilisation of Raw Material

Wood is now universally accepted as a pulping material, but it has not been in use to that extent in India. The pattern of utilisation of raw material for paper manufacture in the world reveals that wood forms the basic source of fibrous raw material in all the leading countries manufacturing paper but the mainstay of paper industry in India is bamboo—non-wood fibres. The reason for this seems to be the heterogenous character of the broad-leaf forests coupled with the lack of suitable technology for pulping them, which is not fully developed so far in underdeveloped countries especially in India. In India bamboo meets more than 65 per cent of the total requirement of raw material for paper and pulp industry. India is the only country where bamboo is used for paper manufacture on such a large scale.

The shortage of all the conventional materials in India has now given rise to the use of hardwoods.

The demand per force has shifted towards other raw materials particularly hardwoods owing to shortage of the—conventional raw materials in India. Both the coniferous and

hardwoods are being used increasingly for the purpose of pulping. Large scale plantations of fast growing species like eucalyptus have altogether changed the supply position in respect of wood raw material. These changes show that the past pattern of consumption of raw material for pulping cannot be regarded as a guide to the future.

The breakup of the pulp, paper and paper-board production and requirement assuming investment in paper industry would be made to the extent so as to obviate import of newsprint, paper and paper-boards and also rayon grade pulp from 1980 onwards is shown in the following table.

Table 11. Consumption and Requirement of Pulp, Paper and Paper board.

Commodity	('000 tonnes)		
	1970	1980	1990
Paper and Paper-board	776	2290	4600
Of which:			
Newsprint	34	500	1000
Printing and Writing Paper	420	900	1700
Industrial Paper	149	450	950
Absorbing Paper	6	50	140
Other Paper-board	167	450	900
Dissolving Pulp	78.7 ¹	300	650

Based on the above projections, the requirement of raw materials and their projections are shown in the table below :

Table 12. Raw Material Requirement for Paper Industry.

Commodity	Unit	1970	1980	1990
Pulpwood	'000 m ³ (r)	746	5050	12732
Bamboos	'000 tonnes	1191	2209	1950
Bagasse, rags, waste products	—do—	496	560	1160

Roundwood

Wood is widely used in round in India, particularly in the rural and semi-urban areas. Wood is mostly used in the form of poles, pit-props, fence posts, rafters for house construction, construction of rural houses and cattle sheds, agricultural

¹An import of 60,000 tonnes of pulp made up the total consumption of 138,700 tonnes shown in the table above.

implements and other uses where there is shortage of sawn wood. A large quantity of such material is produced locally and consumed unrecorded. A major portion of such demand is met from non-forestry sources, viz. agricultural lands and other wooded areas as in the case of fuelwood. Therefore the compilation of use of roundwood from the recorded sources invariably is an under-estimation. This fact has clearly been brought out by the Regional Studies conducted by Pre-Investment Survey of Forest Resources. Production and consumption of this category of wood from the unrecorded sources cannot be easily compiled. Therefore the figures are unrealistic under this head.

After consideration of various studies and comparing the pattern of fuelwood production and consumption in the country from the forests and non-forest sources, the estimated projections for this category of wood is shown in the table below :

Table 13. Requirement of Roundwood excluding Fuelwood.
(‘000 m³)

Year	Quantity
1970	5250
1980	6900
1990	9500

Fuelwood

Fuelwood an important item of production from forestry sector has the greatest gap between reported figures of consumption and actual consumption studied from the end use. Recorded production of fuelwood is hardly 10 per cent of the total requirement in the country. According to a study made by the Pre-Investment Survey of Forest Resources the total requirement of non-commercial fuels are shown in the table overleaf :

From the table overleaf it has been revealed that the consumption of non-commercial fuels has been increasing at nearly the same rate as the population. It shows that there is a positive co-relation between the population and the consumption of non-commercial fuels. The population of the country is

Table 14. Total Requirement of Non-Commercial Fuels
(Million tonnes of coal replacement)

Year	Population (Million)	Non-Commercial Fuels
1953-54	380.2	125.6
1962-63	460.2	152.8
1968-69	532.7	175.6
1973-74	601.7	199.0
1980-81	698.0	230.2

estimated to be 750 million in 1985 leading to the requirement of non-commercial fuels to 250 million tonnes of coal replacement (assuming that there is no change in the composition of energy). It has been estimated that the total consumption of non-commercial fuels was 175.6 million tonnes of coal replacement in 1968-69. It comprised as follows :

Table 15. Consumption of Non-Commercial Fuel as Coal Replacement in 1968-69.

Fuelwood	---	130.0 million tonnes of coal replacement	74.0 %
Cow-dung	—	12.0 — do —	6.8 %
Vegetable waste	- -	33.6 — do —	19.2 %
		175.6	100.0 %

Thus fuelwood comprises about 74 per cent of the total consumption of the non-commercial fuels in India.

The pattern of consumption of fuelwood is also likely to change more quickly than the utilisation pattern in the other wood products which are generally in the more organised sectors. Therefore, the estimates for fuelwood consumption have been made for a five yearly period for 1970, 1975, 1980 and 1990 as follows :

Table 16. Projected Requirement of Fuelwood.
(Million m³ solid)

Year	Requirement
1970	203
1975	233
1980	256
1990	300

Non-Industrial Bamboo

Bamboo is a non wood forest product which is used for both industrial and non-industrial uses. Bamboo is mainly used for pulp and paper industry. The non-industrial uses comprise domestic consumption and cottage industries in the form of mats and baskets and other assorted goods. There is a large population which specialises in this art, viz. cottage industry. Basket making is one of the recognised cottage industries. Bamboo is also used as poor man's timber in the construction of huts and temporary dwellings. It is used widely for this purpose in Uttar Pradesh, Bihar, West Bengal, and Assam plains. There is no systematic study in this respect. There is no record of bamboo production from the non-forestry sources viz. village sites and individual 'baris'. The estimated consumption in this respect is given in the table below :

Tabel 17. Projected Requirement of Non-Industrial Bamboo.

		('000 tonnes)
Year		Non-Industrial Bamboos
1970	1640
1980	2250
1990	3130

Minor Forest Produce

The minor forest produce is differentiated into three categories for the purpose of making projections regarding the raw material requirement, viz. (1) tendu leaves; (2) resins and gums; (3) other minor forest produce put together.

(i) *Resin* : The present annual production of crude resin in the country is about 45,000 tonnes, which yields about 33,500 tonnes of resin on distillation and 7,100 tonnes of turpentine oil. The projected demand of resin by 1975 for different industries is estimated to be of the order of 55,000 tonnes as under :—

<i>Name of Industry</i>	<i>Demand in tonnes</i>
Paper	20,000
Soap	12,000
Paints & Varnish	1,5000
Rubber	3,000
Others	5,000
	55,000

Likewise the industries having their base on turpentine oil, viz. camphor and other products will definitely require more and more turpentine for their future expansion programmes.

(ii) *Tendu Leaves* : The present production of tendu leaves for manufacture of 'bidi' in the country is over 2.0 lakh metric tonnes. Bidi leaf is also exported. The Ford Foundation have projected production requirements to be 4.0 lakh metric tonnes from 1970 to 1990 without any change in respect of 'bidi' leaves.

(iii) *Tannin Material* : The principal vegetable tannin materials used in India are wattle bark, myrobalan fruits, avaram and babul bark. The total annual requirement of vegetable tannin material is estimated to be 25 lakh tonnes. This quantity includes from 10 to 15 lakh tonnes of wattle bark. The rest is imported to meet the bark and tannin extracts valued at Rs. 30 million annually. The production is estimated to be 30,000 tonnes only by the end of Fifth Plan.

(iv) *Natural gums and gum resins* : Out of 13 items of natural gums, gum karaya (*Sterculia urens* gum) occupies the most important position. Next to it is gum ghatti, a gum obtained from *Anogeissus latifolia*. The production of these gums is not known definitely, but it is estimated to be in the vicinity of 15,000 tonnes. Gum karaya is mainly produced in Madhya Pradesh, viz. nearly 50 per cent of the total production. Other states producing gum karaya are Andhra Pradesh, Maharashtra, Orissa, Rajasthan, Gujarat, Tamil Nadu and Karnataka. This gum is exported to U.S.A., Japan, U.K., France and West Germany. In 1968-69, 5337 tonnes of this gum valued at Rs. 26.7 million were exported. The export quantity were increased to 5787 tonnes valued at Rs. 39.3 million in 1971-72.

Recreation: Why does man need recreation ? It is because the monotonous life in the cities irritates him. The high intensity of growth in the urbanisation in the world has changed the complex of the city life. Greenery has altogether vanished from urban landscape on account of fast growth of urbanisation in the world. So far this condition has not reached India. Therefore it has not been necessary to create recreational facilities in this country. After Independence the growth of industrial

complex and consequential to it the growth of cities has posed problem of creating recreation resorts in India too. The Forest Department can create holiday resorts in forest beauty spots by providing simple tourist accommodation such as small cottages run at cheap rates. This can arouse tourist interest in the forests. Such steps are likely to boost the economy of the agriculturist population living close to the forests. Forest Corporations may be able to provide such centres close to the forest rest houses by investing some modest amounts in the programme. This will help create good relations with the local population.

The urban population needs recreational facilities greatly with every increase in population of the country. Most locations in urban areas are congested and lack open space and parks. This fact reduces the chances of improvement in the quality of life in the cities. Therefore recreation is the need of the hour specially for the younger generation. Their energies are very often misdirected in many undesirable ways owing to lack of recreation facilities coupled with other reasons. Anyhow the problem is mainly to maintain and develop human environment. The United Nations in a conference held at Stockholm in June 1972 considered a Declaration on the Human Environment which reads as follows:--

“Economic and social development is essential for ensuring a favourable living and working environment for man and for creating conditions on earth that are necessary for the improvement of the quality of life....Education in environmental matters, especially for the younger generations, is essential in order to broaden the basis for an enlightened opinion and responsible conduct by individuals, enterprises and communities in protecting and enhancing the environment”¹.

Recreation forestry is liable to contribute on two counts, viz. in social development and education in environmental matters. It is suggested that small blocks of forests in the vicinity of urban centres should be dedicated to provide recre-

¹UNESCO, Office of the Chief of Mission in India.

ation, or tree groves may be created to be used as picnic spots etc. for the urban populace.

Recreation forestry can be divided into two kinds, viz. (1) which provide for holidayins in the forests and hills having suitable holiday resorts with boarding and lodging facilities for the tourists, and (2) which provides for picnic resorts close to congested urban centres. Such spots will provide fresh air, greenery and recreation to the population during holidays. Bannerghatta a National Park has been established near Bangalore. This park has been created on an area of about 100 sq. kms with the sole objective of providing both the wild fauna and the tree growth. This complex has Safari Parks with separate large enclosures for lions, tigers, baboons covering an area of 14 sq. km. (1400 hectares). At the entrance of the park artificial tanks have been created for the migrating ducks to settle down in these tanks during winter season to give an added attraction for the picnic parties. The animals which collect near the water-holes and salt-licks in the valleys can be viewed by the visitors at the observation points. There are arrangements for the visitors to drive through the park. The park also have the services of aerial ropeways between vantage points to travel over the Safari park. The organisation provides facilities to take people around for a nominal charge. The picnic corner is spread over an area of about 12 hectares. This wooded area can be utilised by the visitors for spending some-time either before entering the park or after. This place has all facilities viz. tents for camping, accomodation for parking of cars, supply of drinking water and electricity. This place has a serpentarium, pet's corner, deer pen, diorama, museum, curio shop etc. Children usually grow up in densely populated urban cities without an opportunity to see varieties of animal life, trees or birds. Such a facility would provide a good balancing feature for proper human development. The visitors can be charged for these facilities in line with the zoo. The funds collected through levy of fees may not suffice for the maintenance of the parks. The State Government may subsidise the shortfall. This expenditure seems to be legitimate for providing recreation facility to the urban population living in the congested parts of the cities.

Every State may not be able to provide a beautiful sight like Bannerghatta which is about 24 kms. from the heart of the city. Therefore, every State cannot follow the same pattern of development but the State can easily provide some tree-grove, on suitable sites for picnics or dedicate parts of forests near urban centres for picnic corners. Most States have tried to open up outdoor centres near big cities and have got experience of how the younger generation can avail of the facilities. On this analogy every State should study the problems of the recreational needs of the urban populace. Green belts around cities, should be created according to need.

As the planning for recreation forestry has to be started from scrap, it is very difficult to assess the existing stage in the country, the need for funds for this purpose during the Fifth Plan period. The Bannerghatta project in Karnataka to be completed in two phases, is likely to cost the State Rs. 40.6 million. Major part of this outlay will be spent as wages under the supervision of Forest Department. This total allocation includes Rs. 1.7 million ear-marked for the picnic corner together with serpentarium etc.

CHAPTER 6

Forest Products

The production goals in forestry can be assessed in either of the two ways, viz. (1) from recorded sources of origin in the forests or (2) by working back from the finished goods available in the market for consumption by the consumers. Production of timber and logs can be assessed from recorded sources whereas the demand for pulp and paper can be worked back from the production of recognised industries. Since a large quantity is utilised near the source of production, it escapes accounting. Production of wood and other forest products is made outside the forestry sector on farm land and wastelands. A study of forestry sector cannot therefore be complete without a comprehensive industrial planning there.

Factors Influencing Timber Production

Before discussing the economic aspects of production in forestry it is better to look briefly at certain peculiarities of the timber producing process. If timber production were identical to other productive business activities, there would be little reason for special courses being conducted in respect of forest management or forest economics. There are some existing differences that make timber production quite distinct in an economic sense from other production activities. Following peculiarities are worth mentioning.

(1) Immobility

Once the seedlings are placed in the ground to become forest it is fixed capital. It then becomes definitely immobile. This fixed capital comprising several inputs, differs little from that of most complex commodities—e.g. automobile factories, which both are difficult to move. But the main difference lies in that the product in itself is immobile in the case of timber production. Thus stumpage must be sold where it stands. This fact plays a leading role in fixing the price of the final product—the result of the forester's efforts. It is true to say

that the forester may produce logs of different sizes to sell them in distinct markets. But the sale proceeds which he receives can no longer be attributed to his efforts for timber production. It then becomes a combined effort of production and logging. Therefore this return must naturally be distributed between production and logging efforts.

(2) Time Factor

The production on the stumpage in the forests requires far longer time periods than it is needed in any other productive effort. Plantations may mature for harvesting under ideal conditions within a period of ten years. Fuel plantations also take about 10 to 15 years. Sal and teak plantations mature for harvesting even after 80 years or more. Generally it can be taken as 25-year time span between plantation and harvesting. All production requires time. The time factor so large in forestry differs only in degree. This changes the analytical techniques and decision making process altogether. This factor gives forestry a "peculiarity" of production.

(3) The Dual Nature of Standing Trees

The forester has to decide firmly as to which trees are to be marked for felling when the trees are ready for harvesting in the forests. He has to decide in two ways, (1) whether the particular product is ready for exploitation and (2) whether he should destroy that portion of his timber producing factory. The standing trees become the final product as well as the factory which produces the product.

(4) Aggregative Nature of Forests

A lonely tree or a group of trees standing somewhere cannot be termed forests. The trees growing in a community are termed as forests. Their individual entities are not counted in existence. Every tree is related to those trees standing immediately surrounding it. A tree becomes part of forests when it is influenced by the environment of the other trees standing nearby and also get influenced by a host of conditions. The aggregative nature of forests means that the management takes cognisance of the ecological factors and forces. It is this peculiarity which has given rise to creation and adaptation of an entirely new set of management tools.

(5) Externalities

Timber production possesses many externalities because forests are spatial. They produce both products and services other than wood (recreation, scenery, etc.). Timber harvesting always involves costs which the operator does not bear, e.g. silting of river dams, water pollution, soil conservation problem, etc. Thus the management of the forests is somewhat different from that of other enterprises. The forests contain public utility in them.

Economics of Production in Forestry

The supply of forest products—short-run and long-run—depends on those quantities which are offered for sale at different prices in the market. Supply depends on production which really hinges on the problems involved in the actual production of various forestry products. We are going to discuss in this chapter the economic characteristics of the productive process on which the supply decisions depend.

Production Decisions

The productive activity in forestry can be carried out on the decision as to: (1) what to produce, (2) how much of a product to produce, and (3) decision about the efficient method of production. These may be reckoned as the basic decisions in production. The welfare of the people depends upon wise decisions. In a free enterprise system the function of making decisions is attributed to the entrepreneur, who invests his savings coupled with some borrowed capital in the construction of a building, equips it with necessary saws, lathes, and other machines; employs labour, takes contracts to buy lumber and finally starts the factory. Then he decides about handling his business. The risk of losing the effort and capital is involved if he somehow takes a wrong decision. But in a large pulp and paper mill no individual can be called entrepreneur. The policy decisions are taken by the Board of Directors and some members of the Board may risk a personal investment in the business on account of these decisions. But the presidents, vice-presidents, plant managers, wood superintendents, foresters and many more employees decide about the operations. Many of them do not invest their personal capital into the mill. It is a very

complicated process to take decision in a large business organization. The most important thing is the entrepreneurial function.

The main function of production decisions is to use economic resources for optimal efficiency. The question arises as to what is the measuring rod of economic efficiency in the use of resources? Such a measuring rod is related to objectives of the owners of the resources and the entrepreneurs who use them. These objectives are various which make their evaluation difficult. The aim of the economists is to obtain a maximum net revenue or pure profit from a productive activity out of these objectives. It must be remembered that there are other objectives also which affect economic behaviour. The analysis is based on the assumption that net revenue is the measuring rod of economic efficiency. Then the question comes as to how the revenue can be maximised out of productive decisions? The use of input-output analysis is the criterion to decide this. This is balanced by weighing the output obtained against the inputs employed for each of the possible alternative production arrangements. The unit of a commodity is taken to be output or the sale price of the total quantity produced. Input comprises raw materials, the hours of labour, the capital equipments employed, the land which is in use, and the services of management involved in the production. The price of all these commodities added together, gives a unit figure for input.

Production becomes the most efficient or it reaches its optimum if (1) a given input maximises the output, and (2) a minimum input is used for a given output. Assume that a forest contractor has 100,000 trees standing in the jungle to his credit which he can fell and sell in the market. He has a crew of men and the necessary tools and trucks to operate. Now his experience tells him that he can produce 100 ballies (long poles) in a given time to deliver them to a nearby treating plant. He also knows that he can produce 10 cubic metres of ply logs in the same time and supply them to a plywood factory with a given input. He has to decide which is the better course for him in between the two options. An inquiry reveals that the ballies sell at Rs. 10 per piece while the ply logs sell at Rs. 13 per cubic metre. He can produce ballies worth Rs. 100 or ply

logs worth Rs. 130 with the same input. His choice obviously falls on the production of ply logs.

Here is an example of an opposite approach. Imagine a forester has to afforest 100 hectares of open land. He has the necessary seedlings in his nursery ready for planting. He estimates that he can finish his job within 30 days with the help of 100 labourers at a wage rate of Rs. 5 per day. Thus the total expenditure would come to Rs. 15,000. Alternatively the same job can be performed in the same time with 60 labourers and a tractor which can be hired at Rs. 100 per day. The total expenses in this case would come to Rs. 9,000 as the wages of the labourers and Rs. 3,000 as the rent for the tractor. Thus the total inputs come to Rs. 12,000. Now the forester has two alternative inputs which will produce his desired output of 100 hectares planted with trees. He can plant entirely by hand with an input of Rs. 15,000 worth of labour or he can plant with the help of a tractor and labour which will involve an input of Rs. 12,000 in all. Thus it becomes clear that the second alternative gives him the desired output with a minimum input. In India there is the problem of unemployment. The provision of employment is also to be kept in view. This is a social problem and has an upper hand while dealing with economic analysis.

It is to be noted here that most input-output analysis in forestry are not so simple as the above quoted example but they are much more complicated requiring more sophisticated techniques.

Technological Changes

All economic decisions relating to production are based on technological data. Silviculture and engineering aspects cover the methods and techniques employed for growing trees and manufacturing wood products. The technologist changes them into the economic problems after working out the different ways and means which determine the physical inputs and outputs involved in each method. Then the values of the inputs and outputs are calculated to decide about the economic efficiency of the methods.

Suppose the forester wishes to fence a plot afforested with trees. He can either use deodar posts for fencing which are

naturally durable, or chir posts after proper preservative treatment. Now the question arises about the durability of both deodar and chir posts. The lifetime of a deodar post can be ascertained by a wood technologist after a proper study and research. The technological data on account of which the technologist can conclude that a deodar post has an average usable life of, say, twenty years come to play its role. Furthermore, if the lifetime varies with size, density, and other characteristics of the post or soil conditions, it is again technological data involving no economic analysis so far.

On the other hand a great mass of technical data is collected in the process for developing and testing various chemicals and methods of testing chir posts. It is just possible that one chemical may be highly toxic but does not have the necessary penetrating effect into wood while the other penetrates well into the wood but its characteristic is that it is soluble in water. On account of which it leaches out when the post is driven into the ground. Thus the life span of the posts in the ground depends on chemical treatment. At this stage the economics comes into picture for making an economic decision. It is easy to determine the price of the materials. The cost of various processes are calculated. The use of this data along with the life-expectancy data of the posts can be used for working out the cost per post per year for each kind of post. Thus the economically most efficient post can be determined, e.g. involving minimum input for a year's output of post utility in the fence. The above discussion reveals that economic efficiency depends on technological efficiency. The silviculturist has to find out a good site for growing healthy trees. He has to work out ways and means for reproducing different species after harvesting the various ones. He is not concerned with the economics of these methods. The economics has an important role to play in guiding the silviculturist in so far as to what kind of data he should develop as a step towards economic decisions by foresters.

The output of any given productive process is a function of the input. The production function is defined as a relationship between the rate of output and the rate of input. This is important to note that production is a process and therefore

always requires some period of time for its completion. Thus the output of a sawmill cannot be indicated as 100 cubic metres, instead it must be shown as 100 cubic metres per day. In the same way the input can be represented by the use of one sawmill for one day and the services of 100 men for one day.

The quantity of some productive factors may be limited. The sawmill owner might have only one saw with a minimum amount of equipment to prepare lumber—carriage, power unit and a simple log deck and also some shelter for the machinery. This will be called fixed input for his production. Other factors which can be obtained at will, are called variable inputs. His credit standing may not be very high to buy more equipment. Thus in this case he can use capital equipment as fixed input for production. In these circumstances it becomes his problem to decide how much variable inputs he should use with his fixed input—sawmill. He can certainly employ more labourers, and hence the services of the labour are a variable input. Thus his production, e.g. output will vary with the variable input of labour services, though fixed capital—inputs—is also necessary. The following table clarifies this situation.

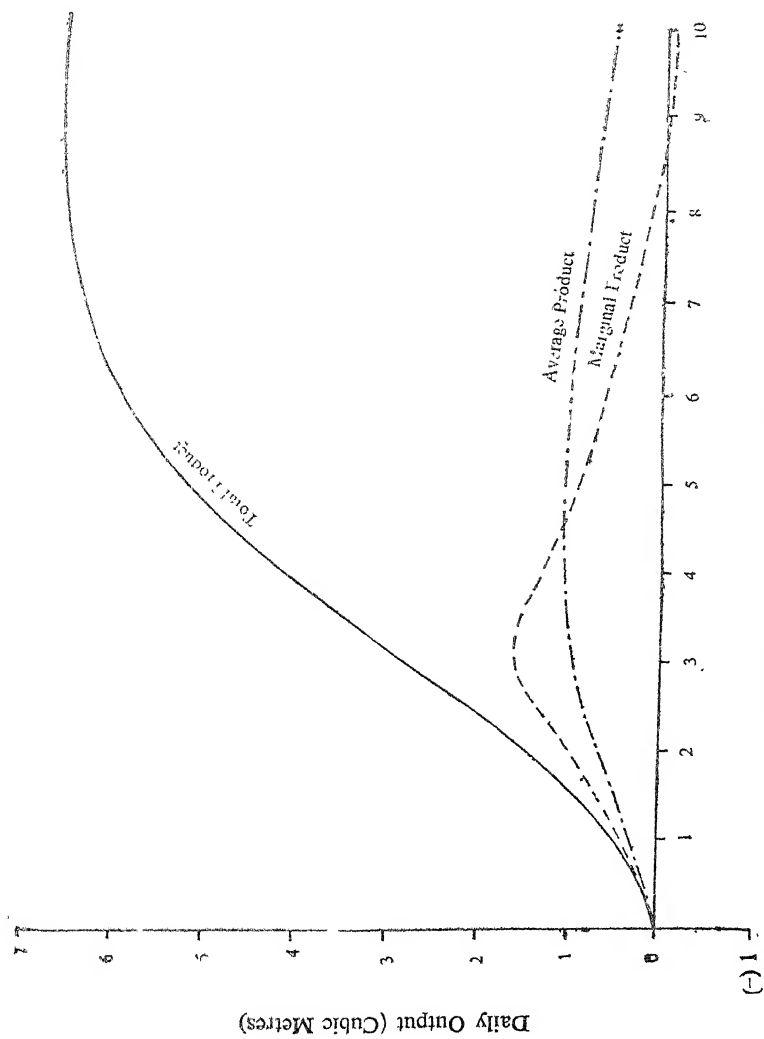
Table 18. Relation of lumber production to size of Crew in a Small Sawmill Daily production in cubic metres.

Number of men employed per day	Total production cubic metres	Average production cubic metres	Marginal production cubic metres
1	340	340	340
2	1,340	670	1,000
3	3,000	1,000	1,660
4	4,340	1,085	1,340
5	5,340	1,068	1,000
6	6,000	1,000	660
7	6,465	923	465
8	6,665	833	200
9	6,665	740	0
10	6,640	654	(—) 125

The first two columns of the above table show the production function in respect of lumber production operation. The first column indicates the rate of input or variable capital—the number of working men. The second column indicates the

rate of output, e.g. the total cubic metres of wood produced per day. Since the mill has no capacity to work of its own, no output is expected out of it without some input of labour services. If one man operates the mill, he is able to produce about 340 cubic metres of wood with all his efforts. When a second man joins hands with him, they would be able to produce 1,340 cubic metres of lumber per day with better managing capacity etc. Thus the larger is the employment of men—inputs—the greater is the output. In this case the output continues to expand up to the input of 8 men days. After this when the 9th man joins the crew, he does not produce anything as the output in both cases remains the same. In this process the ten men crew actually produces less than the nine men crew owing to the operation of diminishing returns. This input-output analysis is shown in the following graph.

The calculation of average and marginal products clarifies the functions of the variable factor of production. The average product is merely the total product of the whole crew put together divided by the number of men employed in the crew. The average production continues to rise up to the employment of the four men. Two men working together are much more efficient than one man to produce 670 cubic metres of wood each. The average production continues to decrease gradually as more men join the crew. Economic analysis hinges more on marginal product than the average product. The marginal product is the amount which is added to the total output by increasing an additional unit of variable input to the total variable input. In this operation the one man crew produces 340 cubic metres of wood but the two men produce 1,340. Thus it is clear that the marginal output 1,000 cubic metres, is due to the additional man though the whole product is the result of two men crew. It cannot be attributed to one man. The marginal product continues to increase up to the addition of the third man. Thereafter the additional successive variable unit adds less to the total output. Thus the marginal product of the ninth man comes to zero as the product of eight man crew equals the nine man crew. The tenth man actually shows negative results. Thus it is clear that the marginal productivity of the variable input finally begins to decrease with the addition



Variable Inputs (Number of Men)

Fig. 8

of more and more men. Thus the "Law of Diminishing Returns" begins to operate at this point. The wood production function gives a complete range of possible alternatives. In the beginning the marginal productivity continues to increase until the third man is employed and it begins to diminish thereafter. It is followed by the area of decreasing marginal productivity. Finally there comes the area of decreasing total productivity beyond the nine man crew.

All these production functions may not appear under all circumstances during the operations, e.g. the area of increasing marginal returns does not seem to appear at all with the addition of the second unit of variable input. A wood cutter cuts a certain number of trees with a chain saw—fixed input and the variable input—labour. Two men working together with one chain saw will certainly fell trees as one man should have done but not twice as much, while a three-man crew with one saw will not be able to cut more than two trees. And four men may not fell even more than three.

Physical production function and operational efficiency are inter-related. The example of lumber production clarifies two areas where the use of inputs is not rational. The total output will decrease if the sawmill owner employs beyond nine men. It will be a definite liability on him to employ the tenth man. It is never an economic proposition to operate in an area having negative marginal productivity.

It is also not economic to operate in an area of increasing average productivity. The sawmill owner cannot use less than four men to operate the mill economically. If he employs one man to get 340 cubic metres per day, profitably he will still have more profit if he employs four men to get 1,085 cubic metres per day from each of the man for the same wages he was paying for getting 340 cubic metres of wood. The is true in a free competition.

Now look at the situation from another angle. Suppose the mill owner has two mills having similarity in them. He is not able to employ more men but runs the mill with a limited variable inputs, e.g. two men in each mill. Thus by working both the mills he is able to get 2,680 cubic metres per day but if he closes down one mill and employs all the four men to

work in one mill, he is able to get 4,340 cubic metres of wood per day for the same input in wages. The same arguments apply in the case of the forester who has 100 hectares of land. Assume that he has some amount of capital equipment—machinery, building, etc.—which he cannot change during the current season of the year. So this is also counted as fixed input. However he has the option to employ more men varying in number. He can use any amount of seed, fertilizers, chemicals and water etc. Now he has two variable inputs—labour and materials. He can make different combinations of these inputs. He will be able to grow nearly the same number of seedlings with different combinations. He may use a lot of fertilisers, herbicides, fungicides, and other materials curtailing many man hours of labour or he may chose to employ more man hours for weeding etc. and less of fertilizers etc. Thus it is seen that labour and materials can be substituted for each other in a productive process. If he increases the input of one of these variables and keeps the other factor intact, say, he employs the same number of men but changes the doses of fertilizers, the total output of seedlings will definitely increase but the marginal product will after all diminish. In case of using more than one variable factors, the output depends on (1) the proportions used for making the combination of variable factors and (2) the total input of the combination of variable factors. Thus it is clear that the rule of diminishing marginal productivity applies in this case just the same way as in case of one factor being variable.

So far the discussion centred round the physical relationship in production and the output in units of a commodity to input in units of the productive factors used. Sometimes it is easy to make economic decisions on the basis of the physical data alone while in other it becomes most difficult to decide about the economic decisions. The input and output units cannot be compared as long as they are not in some comparable units. In many cases both inputs and outputs differ in units. The economic decisions can be made by reducing all inputs and outputs to common value terms which is known as expressing them in monetary terms. Different terms are used to discuss economic production decision. For this purpose Revenue is

the monetary value which is received as sale proceeds of an output of a productive process. Cost is the monetary value spent on all the inputs which are essential to be used in the productive process. Therefore input-output analysis can also be called cost-revenue analysis, showing inputs and outputs in common comparable units.

Relationship Between Revenue and Production

The Revenue obtainable from producing any commodity depends on (1) the quantity of the commodity produced and (2) the price at which the commodity can be sold. The total revenue from a productive operation during some period will be equal to the number of the commodity sold during that period multiplied by the selling price per unit. An increase in the rate of production is likely to enhance the total revenue. But again the total revenue depends on the selling price. The price of a commodity depends on the demand for the commodity in the market.

The demand of a commodity is perfectly elastic if it is sold in a purely competitive market. In this case the product forms a small part of the whole product demanded in the market. It perfectly resembles the products of many other manufactures. All the units of the commodity are saleable at the same price. In this case the marginal revenue of a producer is equal to the market price of one who expands his business. The total revenue will have a direct bearing upon the increase in the output.

The demand of a product is elastic if it sells in a purely competitive market. A monopolist has to face a downward sloping demand curve. In such circumstances the sales of the product can be expanded by reducing the price per unit. An oligopolist arranges the demand of the industry with some other sellers. The demand curve of the industry is also downward sloping. Under such conditions the oligopolist will have to lower the price of the product per unit in order to expand the sale. These people would try to reduce the price but not too much. Though the monopolist also faces the same downward sloping demand curve he cannot do anything but to lower the price in order to expand his sales. The oligopolist may try to change the demand for his product through promotion,

advertising, or by further differentiating his product, rather than moving along with the existing demand curve by lowering the price.

In case elasticity of demand is not perfect for the product of an individual producer, the revenue will not change in direct proportion to his total output. In this case he will have to lower the selling price of the product per unit for disposing of his increased production.

The following table clarifies this position. The first column indicates the production rate of the plant per month while the second column shows the price at which the dealer can sell the various monthly outputs. Column 3 shows the total monthly revenue which the seller would get at various rates of outputs.

Table 19. Relation of Revenue to Rate of Production in a Sleeper Treating Plant

Number of sleepers treated per month	Price necessary to sell all the treated sleepers (paise)	Total monthly Revenue (Rupees)	Marginal monthly Revenue per sleeper (Rupees)	Marginal Revenue (paise)
1.	2.	3.	4.	5.
10,000	99	9,900	—	—
11,000	98	10,780	880	88
12,000	97	11,640	860	86
13,000	96	12,480	840	84
14,000	95	14,300	820	82
15,000	94	14,100	800	80

If the plant owners wish to enhance the output from 10,000 to 15,000 sleepers per month it will not increase the total monthly revenue in the same proportion because the demand for sleepers is not perfectly elastic. The higher the output the lower the average revenue per sleeper. The fourth and fifth columns show the marginal revenues. These are quite important for making economic decisions for production. Marginal revenue is the amount by which total revenue is increased when production expands by one unit.

Assuming that the owner of the plant is able to expand its production in units of 1,000 sleepers only, column 4 shows

the amount added to total monthly revenue on account of increase of every successive unit of one thousand-sleeper. It is important to note that with every increase in production marginal revenue decreases. The phenomenon is very clearly shown by the last column of the table which gives marginal revenue per sleeper added to total output. A look at the table clearly shows that with an increase in production from 10,000 to 11,000 sleepers per month, the average revenue goes down by 1 paise, from 99 to 98 paise per sleeper. At the same time the marginal revenue for the additional output is 88 paise per sleeper. Though it is true that all the 11,000 sleepers sell for 98 paise per sleeper, the additional one thousand sleeper add only 86 paise per sleeper to the total revenue. When the production rate is stepped up by another thousand sleepers thus enhancing the total production to 12,000 sleepers per month, the average revenue further declines to 97 paise while the marginal revenue drops down to 84 paise per piece for the additional thousand sleepers to the total revenue. One phenomenon is notable here that the marginal revenue tends to decline faster than the average revenue. Finally when the production level reaches 15,000 sleepers per month the marginal revenue drops down to 80 paise per sleeper. Following graph shows the relationship between marginal revenue and the average revenue.

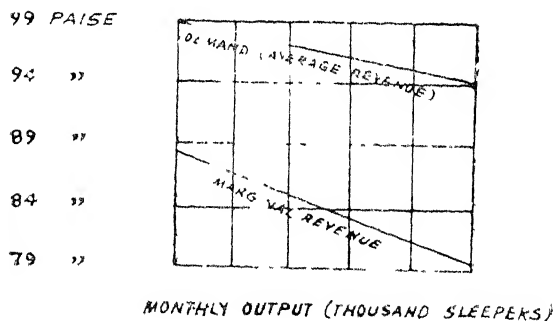


FIG. C DEMAND AND MARGINAL CURVES
OF SLEEPER TREATING PLANT

Cost of Production

When the values of the inputs used in a productive process are measured in terms of money they are called costs. The values are usually determined by the price paid for the services of the factors of production—inputs. Suppose a productive process is required to absorb 150 man days of a labourer to finish a certain job. If he is available at a wage rate of Rs. 8 per day, the cost of his labour input will be Rs. 1,200. In other words the services of the labourer are available @ Rs. 240 per month. If the operation requires a building where the labourer is supposed to work, the rent of the building is Rs. 150 per month, it will be the cost of the input of building. These are called market costs, which are used directly in economic analyses of production.

Now the market costs do not clarify the whole substance. It is to be seen here why productive factor gets its price in the market. Why do people pay Rs. 8 per day to a labourer for his labour? It is simple arithmetic that he will not work for them gratis. The above fact does not include the effect of the trade unions etc. At the same time he cannot get Rs. 8 per day if his services are not worth it. The lowest price at which he would be willing to sell his labour is determined by the best alternative price which he might be able to get for his services elsewhere. However nobody would be willing to pay any price for his labour if he does not do something valued by others. So he must be able to produce something for others worth Rs. 8 per day. The price which must be paid to him for his services is usually determined by the maximum value that he can produce in some alternative form of production.

Market costs and the alternative costs are not invariably the same, unless the market is perfectly competitive. Such a market exists with a perfect knowledge and perfect mobility of resources, which are uncommon. Suppose a forest contractor employs a labourer at Rs. 10 per day who cuts wood worth Rs. 10 in a day. After some days he employs him on pruning work. He prunes some trees. Therefore the cost of labour in the pruning operation is Rs. 10—an alternative cost, while the market cost is Rs. 8 only. Such a situation is unthinkable in a

perfectly competitive market, as some other producer would enter the business. Then he would either bid up the local wage rate to Rs. 10 or force the wood prices to go down to that point where labour could earn only Rs. 8 for an employer by producing wood. But due to imperfect competitive markets this cannot prevail in the market. Thus difference between market cost and alternative cost of labour is bound to prevail in the market.

“Normal profit” is a special type of alternative cost. Suppose a man wants to convert his present business of trading in lumber to run a sawmill. His annual profits in the present business is Rs. 50,000, e.g. “normal profit”. How much should he count for the cost of his own services and those of capital he is going to invest for making a cost returns analysis to determine the profitability of the new venture. He should count his normal profit as a cost in his cost-returns analysis. If the analysis shows that the sawmill is a profitable proposition after paying all other costs plus his normal profit, he will have no hesitation in changing his business to sawmilling.

Money Cost and Real Costs

The production of something involves economic cost. It is the value of all those things which the people have to forego to carry out the production. This is called the real cost of production. This is composed of goods and services used up. Real costs consist of money costs, social costs and implicit costs. Money costs comprise the out-of-pocket payments which are necessarily made for the goods and services essential for production purposes. Economic analysis is done with the help of money costs. Though the entrepreneur knows it definitely that he is incurring such costs, money costs alone do not usually indicate the complete picture in respect of operational costs. A producer usually uses some inputs without making any payment for them. The cost-revenue analysis is incomplete without the inclusion of these other real costs. Sometimes a producer employs his own labour or capital or land in production, for which a fair value of the services should be included as a part of the costs. Such costs are called implicit costs. These costs do not represent any cash outlay. However, if they could be

put to any alternative use, their owner is sacrificing their value by using them in this production operation. Of course, if these cannot be put to an alternative use, their implicit cost is zero.

Besides money and implicit costs to the producer, real costs include those costs which are borne by other people. Part of the real costs of grazing cattle in the catchment area by the graziers is not paid by them but it is paid by public in general when the dams are silted up with erosion debris from the damaged forest catchment by the cattle. These costs are usually counted under "Social Costs".

Fixed and Variable Costs

It is important to note, in judging whether a particular course of action is profitable, the costs which alter as a result of the action, and which remain the same. A very simple example which distinguishes between fixed and variable costs is provided by the running of a scooter. A man who owns a scooter has to pay certain fixed costs over a period, namely a proportion of the capital cost, insurance, road tax, licence fee etc. When the scooter is used daily, he has to incur expenses on oil, repairs, tyres and servicing etc. These are termed as variable costs with the hour or kilometres the scooter is used. If the satisfaction derived from travel by bus and scooter is the same and there is no question of the scooter owner to sell his scooter, then the relevant comparison in deciding whether to travel by scooter or by bus is to compare the additional costs incurred. If the variable cost of travel by scooter comes to 10 paise per kilometre and the cost of travel by bus comes to 12 paise per kilometre, then it would be less costly to travel by scooter even if the total cost of running the scooter for a certain mileage in the year may be 15 paise per kilometre.

Average and Marginal Costs

Fixed and variable costs are shown in the table on next page for different levels of output. The marginal cost is defined as the cost of an extra unit of output. It is calculated by taking the difference in the values of variable cost of two successive levels of output.

Column (3) of the table shows the variable cost, which rises uniformly with the rise in output. It has a tendency to rise rather more steeply with every increase in output. It is the average cost when total cost is divided by output. It is clear that the average cost and the marginal cost are equal when 6 units of output are produced. A steep rise in variable costs makes marginal cost greater than the average cost beyond 6 units of output. The profits of an enterprise reach the optimum limit when the price of the output equals marginal cost.

Table 20. Derivation of Average Total Cost and Marginal Cost.

Output Units	Fixed Cost	Variable Cost	Total Cost	Average Total Cost	Marginal Cost
1	2	3	4	5	6
1	15	3	18	18	3
2	15	7	22	11	4
3	15	12	27	9	5
4	15	18	33	8.2	6
5	15	25	40	8	7
6	15	33	48	8	8
7	15	42	57	8.1	9

This method has its importance because it is useful for analysing production costs in relation to the scale of output. It also studies the technical and institutional conditions under which production is carried out. There are many occasions when marginal costing is used. It is assumed here that variable costs rise uniformly with output. This makes the marginal costs the same at all levels of output.

As an example to differentiate between fixed and variable costs is to take into consideration whether the Forest Department should own a machine or hire it for use on a certain logging project. It is inappropriate to use pre-determined charges for budget purposes. Suppose the average cost of using a logging machine has been determined at Rs. 1,000 and that it had been in use for 1,000 hours. Therefore it is clear that predetermined charges fixed for this class of machine would come to Rs. 1 per hour assuming that depreciation rate, or price of fuel, tyres and so on were expected in the next year

to remain unchanged. If the current rate of hiring this type of machine is 80 paise per hour, it is easy to conclude that this hourly rate is cheaper than the predetermined rate for machinery owned by the Forest Department. Then hiring is cheaper than owning the machine.

Now suppose that the operational cost for a year was Rs. 1,000 comprising as follows:—

Table 21. Total cost for 1,000 hours operation

(Rupees)		
Fixed costs of depreciation Insurance etc.	Variable cost of fuel, tyres, maintenance and repairs, etc.	
	Overall	Per hour of use
400	600	60 paise

Taking the variable costs to rise uniformly with the use within a feasible range of utilisation, the additional cost of using Forest Department's machine will be 60 paise per hour. It is seen that hiring the machine needs 80 paise per hour. Thus it can be easily concluded that hiring of the machine is not profitable.

Opportunity Costs

The selection of a certain course of action from a range of alternatives, means the rejection of others. The cost of the chosen course is equal to the loss sustained by discarding the opportunity offered by the next best alternative. Opportunity cost is defined as being equal to the net benefit had the next best alternative been accepted.

Suppose a man selects Fiat car out of the offer either to get a Fiat or an Ambassador car. The opportunity cost of hoarded money is equal to the interest received by the owner had that money been invested. Labour and capital—two broad factors of production—must command a market price if they are fully employed in the economy and are freely mobile for employment in their most productive uses. This price will be uniform throughout the country in activities. For example, the opportunity cost of a worker in a sawmill is equal to his

wage since his contribution to the national income would be the same if he moves to other job demanding the same skill.

The concept of opportunity cost is useful in a number of ways. Consider the case of a forester who has some intangible value associated in a given patch of spruce forest in his mind as opposed to teak forest. If the forester views both spruce and teak, then the opportunity cost of teak growing is an economic measure of the alternatives of this course to him.

Cost Structure in Forestry

Forestry is rightly termed a major land-use as compared with horticulture or manufacturing industry. Forestry can be called labour-intensive as well as capital-intensive. Since a single activity cannot have both these characteristics, it is necessary to explain this concept. The use of a great deal of labour in creating the man-made forests and looking after them makes it a labour-intensive project. Logging operations in the virgin and man-made forests needs a high labour input. This view ignores other features which classify forests as basically a capital-intensive activity. Under Indian conditions the value of an acre of forest land may average Rs. 1,000 so that 150 acres of forest land which may require the fulltime employment of one man for maintenance, logging and regeneration implies a capital value of Rs. 150,000. The annual cost of retaining this stock of capital at 7 per cent comes to Rs. 10,500. If the wages of a labourer come to Rs. 800 per year, the wages of the labour costs are 0.70 per cent only. On account of this it can be termed as capital-intensive rather than labour-intensive.

But even in spite of this observation the operating costs are mainly dependent on wages and the labour employed on different silvicultural and harvesting operations. Hence leaving aside the cost of holding capital stock—growing stock—the forester will have to concentrate on the efficiency of the labour. This view does not ignore the growing stock at all. Formerly people put more attention on forest management while more attention is being paid to labour now. Because of the changing structures, as forests alter through time, the cost of structure of an enterprise both the growing and exploitation of wood will vary with age-class, composition, type of silvicultural system and environmental conditions.

CHAPTER 7

Marketing

Introduction

Marketing can be defined in many ways but the Committee of the American Marketing Association has defined marketing as "the performance of business activities that direct the flow of goods and services from producer to consumer or user."¹ Though marketing covers different activities but no one knows them precisely. The definition lacks in so far as it does not point out other ways of looking at the management of marketing activities. The following five, among the many views of marketing, seem to stand out:—

1. Distribution of goods and services concept
2. Delivery of standard of living concept
3. Creation of utilities concept
4. Generation of revenue concept
5. Systems approach

Distribution of Goods and Services Concept

The traditional view of marketing is distribution of goods and services. This concept covers all activities which are not directly connected with the production of the goods, viz. transportation, storage, grading, selling, and all the efforts of wholesalers and retailers. This has been the standard approach for many years. Marketing is still looked at in this fashion. However, the use of this definition creates many problems. Product planning, which was not covered in early definitions, has been now introduced in marketing.

The traditional approach stresses the need of physical handling and distributing the goods and services and undervaluing the marginal decisions regarding pricing, channel and

¹Ralph, S. Alexander (Chairman), "Report of the Definitions Committee," *Journal of Marketing*, October, 1948, pp 202-217. The 1960 revision of the definitions failed to change this definition.

promotion would all be included in the broad category of selling.

Delivery of Standard of Living Concept

Paul Mazur¹, who said that marketing was the delivery of a standard of living to society, professed a different concept of marketing. Since this concept is consumer oriented, the definition has much to recommend it. It is mainly to satisfy the desire of the people in society for goods and services. This definition takes into account the product planning because it contains a vital factor which delivers the desired standard of living to society.

Though Mazur's concept helps to provide an excellent philosophical approach to marketing effects, it does not clarify the nature of activities included in it. If we imagine more clearly and broadly, the sphere of operations of marketing can cover everything. However, so broad a definition of marketing will obscure the nature of activities.

Creation of Utilities Concept

According to the traditional economists the creation of utility determines the value of goods, viz. form, place, time and ownership. The marketing activities strongly affect each of these utilities. The product planning and development create form utility. The marketing manager hopes to increase the value of his product by the alteration of product attribution. Movement of the product from the production centres to the location at which customers need it to buy, create place utility. Channels of distribution creates time utility by buying in anticipation of demand and having the right goods available at the right time. Manufacturers also create time utility with the help of storage inventory. Promotional activities create ownership utility by getting the goods into the hands of people who have the most use for them. Thus, the discussion shows that marketing activities create value through the creation of form, place, time, and ownership utilities.

¹Paul Mazur, "The Standards We Raise" (New York: Harper & Row, Publishers, 1953) pp. 18-28

Generation of Revenue Concept

The consumer was thought to discover marketing responsibilities since the previous definitions were consumer oriented. The generation of revenue approach is company oriented. From the stand-point of view of the firm, marketing generates revenue at a cost which will allow a profit to be earned from the operations. This definition proves all income generating activities as marketing action. The accountant, engineer, purchasing agent, credit man, personnel director, and other administrative personnel—all operate under the assumption that the firm will receive in the coming period of time X rupees in sales volume. However, the bank cannot treat these assumptions as legal tender. Therefore, someone must collect money from society to sustain the activities of the firm, otherwise the firm will perish in the absence of such funds. Moreover the cost of collecting such funds should not be exorbitant. The marketing man will have to incur losses if he does not control expenditure on advertisements, personnel, selling, or the product. The marketing manager should generate revenues at a reasonable cost. Therefore, the marketing manager is one who spends on creating marketable products to exchange them in the market place with revenues. Revenue earning is the first and foremost act otherwise his business will fail miserably.

Systems Approach

It is proved beyond doubt that the systems approach is both profitable and effective to the study of administration of business institutions and their activities. Our society comprises one huge socio-economic system. Millions of interrelated subsystems—business firms, social groups, and political units which have many subsystem—are included in this system.

Marketing can be viewed in two ways:—

1. It is the subsystem within the business firm which conducts all activities concerning demand side,
2. The society comprises people who receive goods and services through the subsystem.

First, the firm keeps a marketing department to represent marketing. Second, millions of retailers, wholesalers, trans-

portation firms, and other institutions which supply goods to the market, also represent marketing.

The terms Micromarketing and Macromarketing which refer to the activities of the firm and society's total marketing system respectively, have been borrowed from economics recently.

Importance of Marketing

Throughout the world, the philosophers have always disregarded the marketers and did not recognise them to the extent they deserved for the good they do to the society. Some critics think merchants and sellers to be villains. But the people would be put to great hardship in case the merchants fail to provide the required commodities to the public.

Importance to Society

Society attaches great importance to the marketing activities which help build standard of living to the people. The consumer has a large number of wants to be satisfied. Our society is based on marketing system to satisfy them. The society will be compelled to switch over to another system of satisfying its desires should the prevalent marketing system fails to perform its functions. The government controls the distribution system in those countries where private enterprise has failed to perform its functions, viz. to supply the demanded goods and services. There will be a great amount of misallocation of resources which will leave many consumers dissatisfied, if marketing does not function properly.

If private enterprise is unable to supply the nation with the required goods and services, the government is there to do justice. Of course, one cannot infer from this that governmental intervention will solve the problem.

Marketing provides employment in production work as well as in marketing activities. It is quite true to say that "nothing will happen in our economy unless somebody sells something". If the Tatas were unable to sell their steel in the market, they could not employ many thousand workers. The classical economist, Adam Smith put stress on the fact that the end of all production is consumption. Nobody will produce

anything if there is no market for it. An efficient marketing manager can increase production activities to a large extent and thus he is able to create many-fold employment opportunities.

Marketing activities involve a large amount of labour in themselves as well as provide production jobs. Many people are employed to man retail stores and wholesale establishments alongwith many marketing personnel in manufacturing concerns. Of course there are other marketing personnel who are outside this classification.

Finally, the importance of marketing lies in the fact that it increases the standard of living of the people through distribution costs. Though the inescapable distribution costs are a necessary evil, they still cannot be seen, worn, eaten, or used. A higher standard of living can be effected by reducing the per unit cost of distribution of goods and service to society. If an able marketing manager can manage a reduction in the prices of his produce from Rs. 2 to Rs. 1.50 by adopting efficient means of marketing, each purchaser of this product will save 50 paise per unit which he can spend to buy something else. Suppose the reduction in distribution cost does not trickle down to the consumer in the form of lower prices, the increased profits of the firm will revert either to the employees of the firm or to its owners. Thus it will increase their standard of living. Suppose these profits are neither shared by the employees nor by the shareholders but these amounts are spent on research on new products or other expansion activities, the society would still benefit through an increased standard of living by means of innovation and expanded productivity. Therefore, in any event, society gets the benefit by an increase in the distributive efficiency.

Importance to the Firm

The firm carries on all other activities on account of its marketing efficiency. Failure of marketing efforts will put the organization in jeopardy as it carries on all other activities on account of its marketing efficiency.

Marketing creates channel of communications between the firm and society. Marketing collects information to feed the top management about what the people in society demand

for products and services. Such intelligence is necessary to run the business.

In the early stage of development, the producer of goods lived close to his market, thus minimising the communication problems. He always received orders from his customers what they wanted. The problem of communications increased greatly as the firms grew in size away from market place. The transport and communication systems were forced to develop on the emergence of national and worldwide markets which were fed from centralized points of production. Marketing is a binding thread between the firm and the market.

Growth of the Importance of Marketing

The development of marketing is relatively of recent origin. For many centuries living conditions were such that people needed no marketing. Since the dawn of civilization man has struggled to eke out a minimum existence. Usually he could produce barely according to his needs. He simply needed some food, a little shelter, and a few garments to keep him warm.

As man progressed, division of labour came into being. Under this system he began to produce more than what he needed. Thus barter system was introduced. In this way more commodities began to be produced. Immediately after this condition marketing came into existence. People faced the problem of disposing of their surplus production to their best advantage, viz. they had to search out other groups - markets—that had surplus of some product which they needed. It was an uphill task to accomplish this feat. Paul Herrmann's book, "Conquest by Man"¹ brought many astounding trade routes that were organized many centuries before the birth of Christ. Trade routes were successfully established for products like amber, spices, silks, and salt. However, marketing consisted of transportation in this era. The availability of such goods was far below the expected supplies. Therefore, the major problem was of producing

¹Paul Hermann, "Conquest by Man" (New York: Haryer & Row. 1954), p. 11.

surplus and safely transporting the quantity in the place where it would procure the best trade.

Even after the Industrial Revolution in the late eighteenth century the emphasis was laid on production because the economy could not begin to produce enough goods and services to satisfy the needs of the people. By 1920 the marketing came to be widely recognized as a separate field of activity.

Marketing has not been uniform in the world since the majority of societies still face a production problem, not a marketing one. There are multitudes of people on this earth who do not get an adequate diet, much less have the ability to procure other types of goods and services.

Marketing as we know it today is mainly an American creation which has developed rapidly as our productive capacity exceeded the immediate needs of society. Under conditions of overcapacity, either plants can be shut down to cease employment, or more goods can be sold.

A mass production and automation become more widespread and as technical research makes possible a multitude of new products now undreamed of by the consumer, marketing will grow in importance because mass production is directly dependent on mass markets and mass marketing.

Unfortunately there are some industries in the world whose markets are so large that even mass production and mass marketing have some difficulty in supplying them. We are feeling shortage of certain critical raw materials at prices we feel we should pay. Marketers are now posed with some interesting new problems.

Marketing is a process of planning and managing sales in order to marry demand and supply to the best advantage of the forest enterprise. It is not simply the negotiating arrangements on prices and deliveries made, but it is also concerned with short-term and long-term yield regulation in the forests.

Since we live under dynamic economic conditions where the supply of and demand for wood are liable to fluctuate with every change in marketing conditions according to time. Demand conditions vary in a variety of ways viz. new usages

of wood may emerge. The use of low-grade hard-woods has come up in recent years owing to change in technology in hard-wood pulping. On the other hand the use of pre-stressed cement concrete sleepers for laying new tracks, has brought down the demand for wooden sleepers. The use of aluminium in the ship building industry has diminished the demand for wood to a new low. Furthermore the use of wood in reconstituted form is gathering momentum in the world. This creates strong demand for sawlogs and a relative decline in the demand for structural practices in the long-run.

The conditions affecting supply do change, though they may be independent of alterations in demand. The recruitment to the thinning or final felling stage of large areas in plantation forests may increase the volume of material suddenly for harvesting. The supply position is liable to change in case the assesment of potential cut increases owing to a new inventory without any change in the volume and accessibility of the forest.

It should be carefully planned to bring in equilibrium between a new demand and the existing source of supply and vice-versa. Sometimes the industry constructs a mill while on another occasion some influential individual may initiate it.

The Forest Department and its Marketing Function

The Forest Department makes some important decisions which are useful for planning and management, in respect of harvesting and selling the output. This function involves at least three executives directly viz., (a) the marketing manager to secure orders, (b) the harvesting manager to keep an eye on a constant flow of the required raw material, and (c) the forest manager to maintain the current yields and future potential cut. The diagramm on the next page depicts this function in terms of desired shifts in the supply and demand curves. The various pressures are illustrated on the net page :—

The marketing manager tries to expand the demand for the forest products.¹ It is done either of the following was and means viz., (1) he may persuade the buyers to buy at higher

¹Johnston, D.R , Grayson, A.J. and T.R. Bradley, "Forest Planning"
Faber and Faber, London 1967

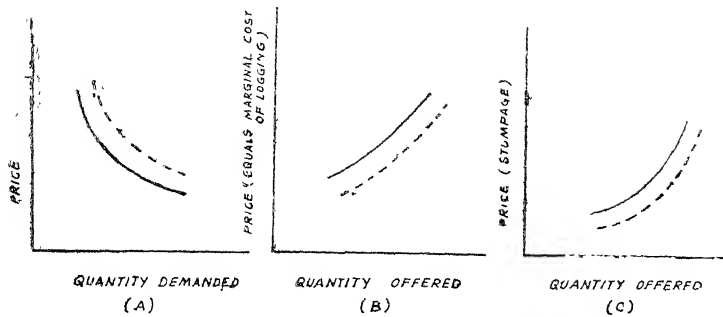


Fig. 10 MARKETING FUNCTIONS : (A) SELLING (B) LOGGING (C) GROWING

price the same quantity of deliveries or (2) arrange to sell enlarged volume of deliveries at constant prices. However, he can perform this function by shifting demand curve to the right in both the cases.

The harvesting manager organizes the logging operation in such a way so as to minimize the harvesting costs by bringing down the current costs. Thus he shifts the supply curve in the direction which is known as a shift in supply to the right, by reducing the price. The gap margin between market price and the new supply curve then measures the harvesting manager's success.

The forest manager enjoys a different position from the other two managers as he aims at having sufficient cut of volume for a healthy and profitable development of the forest but he will never allow the forest's future potential to be jeopardised. He will therefore push along his predetermined supply curve, and will limit the cut to some maximum level of potential cut. An ordinary increase in price will not allure him to enhance supply. Therefore either a big increase in price can tempt him to cut far beyond the normal rate of cut or the National Emergency such as war etc.

The use of some more efficient silvicultural methods of growing trees might lower the cost of growing trees in the long-run but these are insufficient to shift the supply curve in near future. Silvicultural measures which effect supply in the near future, might prevent serious degradation of standing stock or a

fertilizer treatment might response a rapid increment. However, new inventionories and new thinning regimes may cause a shift in the supply curve as shown by the dotted line in the third diagram.

Marketing and its Functions

A market is a place where producers and consumers exchange goods to their mutual interest. But it is also a place where consumer has to face the hard fact of life that he cannot have all that he desires. He has to choose among alternatives according to his purchasing power. The producer assesses the demand of consumers and estimates the relative amount of things which they are willing to buy.

The word market is used in a narrower sense than marketing itself. Marketing is a dynamic and productive process. It performs services desired by the people, and adds value to the goods which are handled there. Marketing comprises an important activity employing a large part of our resources in our present day economy. Our economy involves a great number of people and great distance for dealing with multifinuous products and services.

Marketing is the preference of market services by firms and individuals. The services ordinarily include exchange of commodities and also several other related functions such as market reporting, advertising, risk taking. The subject of marketing should have been much simpler if the markets were run under perfect competition. The horizon of this subject is widened owing to imperfect conditions which prevail in the market. Many types of marketing organizations crop up because of imperfect markets. In fact production is counted a major branch in relation to marketing due to imperfect conditions prevailing in the market.

Many economists think that the "real" production comprises mining, forestry and also manufacturing e.g. in the steel mill and in sawmill. These basic services reach the consumer through the middleman who acts as a parasite upon the economy of a country. The middleman thrives on account of "Imperfections". What to say of the middleman alone, the whole economic system hinges on imperfect conditions.

"Imperfect" distribution of resources gives rise to the transport industry. Imperfect conditions prevailing in natural bounty or in human wisdom are the life and blood of forestry profession. Imperfections give rise to cost. The entrepreneur who is prepared to bear the cost, earns revenues. Thus the whole story gives rise to production

Production is nothing but changing the shape of material and thus adding utility to it to satisfy the consumer's wants. Satisfaction may be divided into many types e.g. satisfaction of form, of possession, of place and of time. Marketing is directed towards these satisfactions. The services of the retailer in lumber trade are equally good with those of the timber grower.

Anyhow the performance of marketing services is done through the firms or individuals who employ their resources for production to bring forth output in the market. Such firms may integrate enterprises—within marketing or between marketing and manufacturing—according to the principles of equating marginal cost and marginal revenue in marketing. Marketing in a nut-shell, is simply to find an outlet for commodities in different places. This is one side of the picture e.g. the seller's side. Marketing is to find a source for the buyer. In short both engage in producing or using manifold services that help selling and buying.

Significance of Marketing

Marketing involves many commodities in the forest economy. First of all forest land is marketed, and then the other agents of production e.g. capital and the services of labour. Last of all the output of these agents, forage, wildlife, watershed services and timber products are marketed. But our central theme of discussion will be timber and its products alone.

The final product of forests is released for consumption through marketing. The work of the forester bears fruit at this stage. Let us suppose that nearly three-fourths of all timber harvested is marketed first in the form of stumpage where the art of silviculture is reflected at the time of sale. Marketing concerns mainly with immediate future while silvicultural practices and other management considerations relate mainly

to the distant future. These marketing practices are liable to change the future course of management. Marketing of the products works as a focal point for conversion management too.

Risk Involved in Marketing Forest Products

Consider the financial services of the market—risk taking. There are usually three types of risks involved in timber marketing e.g. (1) risk of physical loss e.g. through fire, storm, insects, and decay; (2) risk of financial loss, e.g. through price declines or the delinquency of debtors; and (3) risk of technical misadjustment, e.g. in measurement and grading. Such risks increase the cost of marketing. Secondly it curtails the services of marketing. Marketing agencies always try to reduce their stock if risks anticipated are high enough. They try to shorten the period of production. Such actions are known as contrary to resource conservation in the forest economy.

Methods to Reduce Risks

There are many ways to overcome these risks. (1) social actions may be taken. (2) counter-cyclical measures may be used to lessen the economic impact of ups and downs. (3) insurance against risks may be employed. (4) improvement of the informational services of market may be effected.

Competitive Position of Forestry in Marketing

No doubt free competition in market does not exist in respect of forest products. The market price can usually be influenced by individual actions—the buyers and sellers being limited in number. Another factor which comes in the way is the heterogenous character of the product exchanged in forestry market. Really, there is a great difference in the amount of products viz. quality and ease of access. The National markets are comparatively more competitive than the local markets. But these markets too have a tendency towards monopolistic competition. There is virtually no monopoly in forest products. Actually there exists oligopoly in local markets. There is more than one buyer or seller but not enough to affect the market price.

Since private forests are more or less absent in India, the production from the national forests has a great effect on price

variations. Where there are some few buyers or sellers, they think that they can cause a change in the price in the market by their actions. Their tendency is to manipulate the situation to the best of their advantage. The case of a pure monopsony—such a situation in which a manufacturing firm is the only buyer of wood in a particular area—the firm can do this. In such a case the price will have a tendency to fall to its lowest where it can get just enough to operate at its most profitable level. In case of oligopsony where few other buyer firms are active in the same area, the firm will have to consider the effect of its actions as to how the other firms will react.

If there are a few firms, say four, buying in the same area and their buying capacity overwhelms the productive capacity of the area, they may hike the price high enough to snatch the wood from other areas. This is exactly the case of match factories and plywood factories in India. In this process all the firms cannot survive and they might have to quit the market. But if their financial status is strong they will compete well to drag their share of wood. If the productive capacity of the area is increased to the point where it exceeds the collective wants of the firms, they will try to force the price of timber to the level where they can get just enough timber to fulfil their wants.

Although there are no monopolistic trends in forestry in India but the forest department more or less monopolise the wood production in the country. The foresters can sell their produce from the forests at whatever price they like but it is not done in the national interest. In fact the forest department sells the produce at a cheaper rate than anticipated in the market. In case of shortage of timber in the market more timber is released to fill the gap. This action adjusts the price accordingly. In this situation the buyer firms cannot have an upper hand to adjust the price according to their whim. Neither can they force the price to go up nor bring it lower than the competitive prices. In fact free competition does not prevail in India. In the developmental stage the Government is subsidizing the prices as to give incentive to the industrialists. For example match industry gets wood on subsidized rate because matches are used by every individual—poor and rich alike

Then the railways get cross ties on a fixed rate. There is no competition.

Marketing Practices in India

The marketing of different forest products may be studied in India as under :—

(A) *System of Exploitation*: Usually there are three agencies to take care of extraction and disposal of forest products:

- (i) The Government
- (ii) The Government and Purchasers combined
- (iii) The Purchasers

Since circumstances vary from place to place and time to time; it cannot be advocated which of the above agencies is the best suited in respect of (i) working practices and (ii) receiving highest remuneration. It is possible that one of them might do well in one locality, a second in another and still a third in another.

The following conditions must be borne in mind before making decision on selecting either of them for working.

- (a) The maintenance and improvement of forests.
 - (b) The checking of theft by the purchaser or the forest employees.
 - (c) A fair remuneration for the Government.
 - (d) The safeguarding of the interests of the local population.
 - (e) The avoidance of unnecessary complications
 - (f) The physical conditions of the locality.
 - (g) The number and qualification of the forest staff available.
 - (h) The quality and quantity of labour available.
 - (i) The capabilities or financial standing of contractors or purchasers.
 - (j) The consideration of encouraging private enterprise.
- The extent to which any of these factors is to be taken into consideration will differ according to the peculiarities of each case and each set of circumstances must be judged on its own merits.

Let us discuss the merits and demerits one by one.

(i) *Working by Government Agency*: The forest department is required to undertake all operations, viz., felling of trees, the collection of forest produce, the extraction of timber, and the disposal or marketing of all types of products.

Possibly the working details vary from locality to locality with the base of the system remaining broadly the same. The labour engaged on behalf of the forest department collect and store the forest produce at the sale depot. Finally the sale of the produce thus collected and stored is organised by the department. This method is generally called departmental working or extraction. Under this system the forest department engaged contractors for felling the trees, extracting the timber and storing it at the sale depot. The contractors are paid per cubic metre for felling carriage and delivery at a certain depot. The activities of every contractor are necessarily supervised. Afterwards the forest department effects the operation complete. Measuring and counting of the timber is done by some reliable officer who passes the lot for final payment to the contractor. A very careful record of logs passed for payment is required to be kept to avoid the least chance of fraud.

Contractors are paid in advance against very reliable sureties for the purpose of smooth running of their business. Such advances are usually adjusted towards the part payments which the forest department makes to the contractors for the work done by them.

However, the forest department usually prefers private agency for extraction and thus avoids departmental extraction. Anyhow, departmental extraction has its own charm and usefulness in case the regular supply is needed e.g. of firewood. Departmental working is very useful to keep price low to combat scarcity, because the department will work selflessly for the welfare of the people without any motive behind it. Departmental working is also favoured in case of setting up a new industry, e.g. the Neepea newsprint factory, situated at Neepanagar near Khandwa in Madhya Pradesh. This method is the best in case the Government is not able to reap full benefits under some other system.

Generally, the minor forest products are not collected departmentally but it is resorted to as a special case when it is thought to be the best way in official circles. One of the best examples is of the collection of pine resin in the Himalayas and of tendu leaves in Madhya Pradesh for 'biri' manufacture there. The nature of this work is such that it can neither be left in the hands of the contractors for reasons of safety of forests nor would the contractors like to take it up because of the difficulty involved in it.

(ii) *Working by Government and Purchasers Combined:* This method proves very successful with the help of some control over a part of the work. For example, departmental felling is resorted to avoid danger of a loss to the forests during the operation. This follows by the contractor who extracts and sells the produce in the market. This method has been successfully employed in India especially in those areas where thinning is required to be carried out. The Government employs skilled woodcutters to fell the trees on contract basis. Payment is done per tree felled. The extraction is followed by the purchasers. This method is especially beneficial in improvement fellings. This method can ensure the weeding of inferior or harmful trees.

(iii) *Working by Purchasers:* This method is most commonly used in India for felling, extracting and collecting the forest product. The forest staff shoulders no unnecessary responsibility under this system. Besides, it gives rise to a healthy competition among private enterprise. In a large country like India having twenty-two States and nine Union Territories, it is very important to relieve the forest staff from their additional burden over and above the normal duty of looking after large forest areas. This system is the best for the forest department, if there is healthy competition among purchasers.

(B) *System of Sale of the Forest Product:* There are various methods of sale in respect of forest produce and timber in India. These can broadly be divided into following heads:

- (i) Lump Sum Sale;
- (ii) Payment on Outturn

(i) *Lump Sum Sale*: Under this system the Government is sure to get a fixed amount sale proceeds for a lot comprising an unknown quantity of produce. The forest department auctions the lots under this system. Sale may be effected either directly or by tenders. Afterwards the purchaser gets a licence or a permit for a period of time to extract the produce from a certain specified forest area. The exact amount of produce is known only on completion of extraction work. This system absorbs the sale of a lease or a contract for the extraction of marked trees by paying a lumpsum price, but the usual practice is to realise the price of the contract in instalments. The first instalment is deposited in advance before the extraction work actually starts.

This form of sale contract is the best when the quantity of the produce to be sold is not known, e.g. fuel or minor forest produce at a sale depot. But when unknown quantity of standing trees or other unknown produce is concerned, it is objectionable since the amount proportional to the produce extracted cannot be known.

(ii) *Payment on Outturn*: This head covers every type of sale when the produce extracted compares favourably with the amount paid for it. This system covers many varieties e.g. the well known royalty system where the purchaser pays an agreed amount per unit of produce extracted. The payment of royalty is done on volume, weight, or quantity of produce without guarantee of extraction or outturn.

However, a noteworthy fact is that, the system of working and sale are closely connected that the following system of extraction and sale better describes the varieties which are commonly practised in India.

(a) *Sale of a Whole Coupe or Area*: Under this system of person or a firm is solely authorised to extract timber and other produce from the forest area given on lease for a fixed period of time. The lessee has invariably to make payment of the sale contract in lumpsum either in one premium or in instalments. Sometimes, the payment is made on royalty basis, e.g. on the volume of produce extracted from the forests. Sometimes two systems are used in combination. The simplest form is that the lessee pays a lumpsum amount for being

authorised to extract as much produce of a certain kind as the lessee can extract during a certain specified period. This system often fails in respect of extraction of timber or fuelwood as the forest is likely to come to an end very soon but in case of extraction of grasses, fruits, lac, honey and so many other minor forest produce it, no doubt, is the best. Sometimes, it proves to be worst method, e.g. in case of dead timber, as the purchaser is liable to cut even the living trees if allured by selfinterest. Under one set of circumstances it is better to grant a lease for more than one year to the same purchaser while under another it may be advisable not to do so. Thus this system is entirely governed by circumstances. In case of collection of lac, the lessee will try to leave sufficient brood lac on the trees to ensure good crop next year if he is sure of getting extension of his lease for another year. On the other hand, the lease for collection of dead wood must not be extended in any case. It should be confined to the shortest period possible so that the lessee must not be induced to the living trees.

(b) *Sale of Marked Standing Trees*: In this system, the trees are first selected and marked. Afterwards the whole coupe of marked trees is sold either directly or by auction, or tender. The purchaser is required to make payment in lumpsum, or in instalments or by royalty on outturn. The forest department is in the know of outturn on the basis of their estimates. This system of disposal of trees in the forests suits the forest department the best.

(c) *Sale by means of Licences and Permits*: Under this system the forest department notifies the forest area from where the produce—timber or other commodities—are to be extracted within a specified period of time. The intending purchaser applies for a licence or permit authorising him to extract material from the notified forest area. The forest department fixes a fee for a grant of a licence. After paying the said fee, the purchaser begins to collect the forest produce. The terms of reference of the licence in use are checked by the forest officials often.

Many modifications have taken place in this method. For example, some responsible forest officer may have authority to

issue a licence to some purchasers of integrity for the extraction of valuable timber while some lower official might be empowered to issue permits for extraction of petty forest produce. These officials may be employed either on a fixed salary or on commission basis on the revenue collected by them. The payment for such petty produce is made in fixed units, viz., per head load of grass or per cart load of fuel or bamboos etc. Shooting licence authorises the holder of the licence to shoot in a limited area of the forest. Such licences are issued for a limited period of time. It is a common example of this system of sale.

A variety of this system of licencing is commonly known as the computation system. The practice is to issue a common licence or permit to many persons for making one payment. Generally the villagers benefit under this system. It enables them to extract petty forest produce. Sometimes collection and removal of forest produce is done before payment is made to the forest department. Payment of fee is made on the completion of the sale of contract. This system is not good to give a practical shape to it. However, it could be permitted under special circumstances where forests are not easily workable due to the remoteness or lack of communications. Elsewhere it should not be tried as long as alternative is left in hand.

Finally, the forest department applies special ways and means in those areas of forest from where no revenue seems to be coming forth. For example, the production of cutch¹, Lac, and rubber in large areas of unclassified forests of Burma. The Government owns these forests but they are not categorised as 'reserved' forests. They are ladden with rights of the public. Everyone is allowed to fell trees at his will. The khair trees are usually felled for preparing 'cutch' without making payment. It is impossible for the Government to collect any revenue from them. Just to combat the position the Government have however, levied an export duty on 'cutch'. Though the forest department do not get any revenue directly from this levy on exports, but this shows how revenue can be collected in exceptional circumstances when there is no other means of collecting it.

¹Mannual of Forest Unilization—W.H Trotter, 1940 Edn.

(C) *Method of Sale* : Forest produce is commonly sold by means of the following methods:—

- (i) By Private Bargain
- (ii) By Fixed Tariffs
- (iii) By Tenders

(i) *By Private Bargain*: Though it is the most common method of ordinary business transactions, in forest it is seldom applied only under some special circumstances as for the produce which is not generally in demand. There is a single person or a firm creating demand for such a produce. For example, a particular industry may need only a few selected logs or trees. The match industry is a good example of such a case. The current market price or the past sales guide the forest department in finding the price sometimes, while on the other hand the officer conducting the sale may use his discretion if he is not aware of the previous trends. In the case of a produce which was not previously in demand, it is better to keep the price at the lowest level so as to break up “rings” or combinations of buyers at auctions, and on several occasions it has played a wonderful role in collapsing well-organised “rings” of timber-buyers who tried to force down the prices at the auction.

(ii) *By Fixed Tariffs* : This method completely falls in line with the above method except that the price here is prefixed and no change is allowed in the absence of official sanction. Therefore, the trend of price usually resembles approximately the current market rates. The revision of prices is necessary from time to time. The forest department in India uses this method for sale of inferior timber, firewood, bamboos and minor forest products. The forest department conducts the sale at the depots under this system as it requires little supervision and its working is so easy that even the subordinate staff is able to manage the sales. A periodic checking of stocks and sales is definitely needed under this system.

The well-known royalty system is really an adaptation of this method of sale, the royalty being a fixed tariff on all produce extracted from the forest. The method is particularly good for its simplicity in a country where all kind of forest products are in demand.

(iii) *By Auction*: Auctions are conducted from time to time so that the prices may reach their optimal level. This method is commonly in use while selling the forest products. This is the best method when a keen and healthy competition is in existence among buyers. However, necessary precautions should be taken to avoid the purchasers forming "rings" or combinations to defeat the purpose of the auction. Methods like Private Bargaining are good to crush the existing "rings" or combinations.

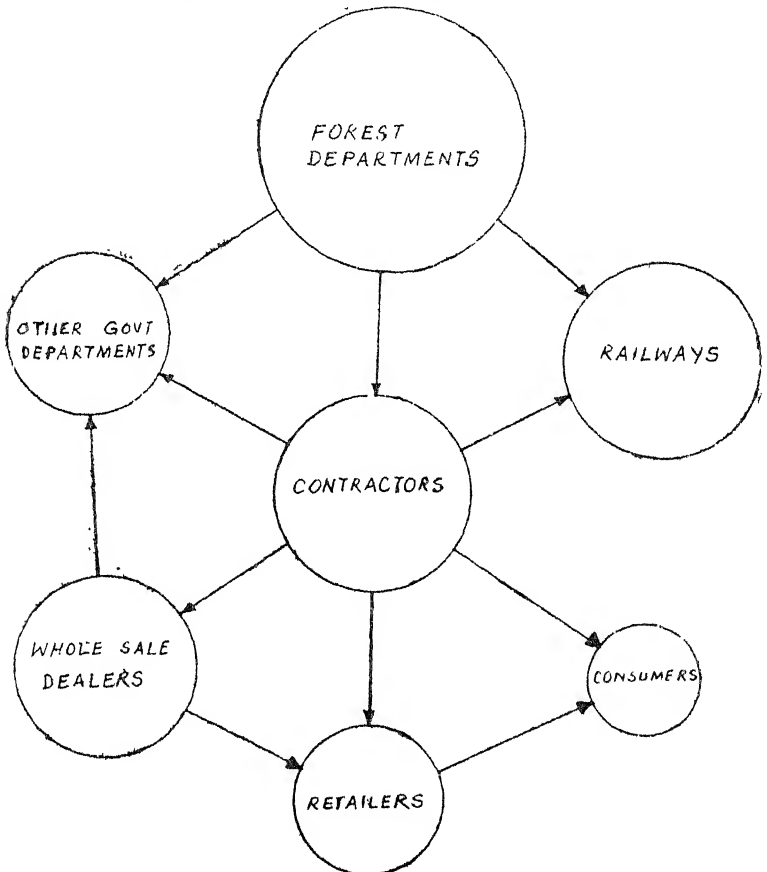
An "upset price" is fixed in case it is feared that a very low price will emerge out of the bids during an auction. Such measures are taken if the forest department does not accept lower bids than the "upset price". It has a good effect on the prospective purchasers as they feel that the lots will be withdrawn in case the bids are not fair.

A variety of true auction sale is named as "Dutch Auction". In this system the auctioneer calls out the highest and lowest price from time to time until someone accepts the price to complete the sale. It cannot be called an auction in its real sense. This method is not favoured in India as it is a time consuming device. However, it is very common in some European countries.

(iv) *By Tender* : This method of sale is very commonly used in India. The prospective-buyers indicate in their tender the rates which they are ready to pay. Tenders are classified as "Open Tenders", or "Sealed Tenders". Under "sealed Tender" system no tenderer is supposed to know the bids of the other tenderers. Under "open tender" system, one tenderer can inquire about the bids made by other tenderers. Sealed tender system can successfully be used to break combination at the auctions in case the produce has a constant value. Sometimes it is not profitable in comparison to auction system. However, the seller is in an advantageous position as the right to accept or reject a tender rests with the seller. The seller can condemn any tender which he thinks to be doubtful or undesirable. An earnest money is definitely demanded along with a tender in case the sale is intended to be effected by tenders. It works as a safeguard against the genuine tenderers.

The following diagram depicts the various operations in marketing. It shows how forest department is engaged distributing timber etc. to various departments and the contractors. The forest contractors cater to the needs of several Government departments, Railways, whole sale dealers, retailers and finally the consumers. The contractors play a major role in supplying timber to different organizations.

MARKETING OF FOREST PRODUCTS



In summing up, the analysis presented in the preceeding paragraphs highlights significance of marketing in more ways than one. The role of marketing seems particularly important

in the forestry curriculum because of the dominant public interest involved in the maintenance of forests and the disposal of forest products, unlike in the case of usual marketing mechanism the prime-mover underlying different marketing policies vis-a-vis forest products has to be maximum social advantage which suggests state intervention. Exact form of state intervention and sequential marketing mechanism and policies will, however, have to be consistent with the broader objectives laid down for the purpose.

CHAPTER 8

Labour Problems in Forestry

“The hand of craftsman engaged in his art is always pure”.—Manu

Introduction

Throughout ages labour has been a creative force in the world. Though mechanical devices have tried to reduce the demand for labour by producing large quantities of consumable commodities at a cheaper cost, machines have not been able to replace man as they cannot be operated without his hand.

Wide differences occur in respect of the number of unemployed people in India. According to the Census conducted in 1971, the population of the country comprised 548 million inclusive of 284 million males. The working force consisted of 180 million viz. 148 million males and 32 million females.

The projected population of the country is estimated at 705 million in 1985-86. Assuming a constant ratio of working force to population, as experienced during the 1971 census, the working force is estimated to be in the vicinity of 250 million. This would mean that during the next 15 years there will be an increase of about 70 million in the working force in India. An increase in population and consequently in working force on such a large scale can be a crippling handicap since the country is already densely populated and the avenues of employment in organised sectors of the economy are rather limited.

According to Marshall there are some special “peculiarities” of labour which distinguish it from other factors. He lists five peculiarities as follows:—

1. “The worker sells his work, but retains capital in himself”.
2. “The seller of labour must deliver it himself”.
3. “Labour is perishable”.

4. "The seller of it is often at a disadvantage in bargaining".
5. "A great length of time is required for providing additional supplies of specialised ability".

Marshall says that the first two of these peculiarities are altogether different from the others. Labour is perishable since it depends primarily on time rather than on the rate of use. Today's unutilised labour services cannot be stored for tomorrow's use. Hence there cannot be a correspondingly larger amount of labour available tomorrow. But this is equally true of much non-human capital—of the services of a bridge or a road or a machine (a typewriter) that deteriorates with time. Economically speaking, the physical characteristics of the typewriter can be preserved but its economic value cannot because of obsolescence.

Again, labour is usually at a disadvantage in respect of its bargaining power. Insofar as there is any systematic difference on this score, it would seem to be an indirect effect of item (1). More generally a "bargaining" problem of any kind arises only when the market is not competitive; and indeed, strictly speaking, only when it is competitive on neither the selling nor the buying side. However, the bargaining advantage depends on which party is the monopolist. If both are monopolists, it depends on their relative monopoly power.

Again, item (5) is at the most a question of degree. It is true of other kinds of capital: the Bhakra and Nangal dam, the Farakka barrage and the investments involved in laying out railway lines in the early stage etc.

Item (1) and (2) differ from others since these are the inherent characteristics of our society. However, these characteristics are unknown to a slave society. The fact that human capital sources cannot be traded means that human capital does not provide as good a reserve against emergencies as is true of non-human capital. Consequently, the larger the fraction of any given total income that accrues from human capital, the greater we should expect to be the desire to save. This fact narrows down the scope of market forces in investment in human capital. After investing in a machine, the individual

owns it and he is sure of getting some return from his investment. However, an individual who invests in another individual lacks this assurance. The individuals have incentives to invest in themselves or their progeny that they do not have to invest in machines. This tendency leaves them with either underinvestment or overinvestment in human relative to non-human capital.

Finally, Marshall's second peculiarity is absolutely dependant on the fact that human capital can neither be bought nor sold. This is the reason why the seller of labour is required to deliver it himself. But this means that non-pecuniary considerations become relevant to the use of human capital as opposed to non-human. The land owner, for example, does not care about its "pleasant" or "unpleasant" use, but the owner of labour-power, on the other hand, is always concerned about it. He is required to make a tie-in contract: his sale of labour-power is tied-in with the "purchase" of the conditions of work, the pleasantness of the task, etc. etc.

The above special considerations which apply to human capital affect its supply in many ways. These need further elucidation. Let us examine the supply of labour in general in the short and long run.

The Supply of Labour as a Whole

Labour is, usually, heterogenous; an hour of an agriculturist cannot be equated with an hour of an engineer. However, it is always possible to construct a supply curve for labour in general by taking for granted some structure of wage rates. For example, we may define our assumed structure of wage rates in terms of fixed ratios of wages. Then these ratios are used to convert actual hours of labour into "equivalent" hours. Suppose the wage rate of the engineer to be fixed at 6 times the wage rate of an agriculturist, then one hour labour of the engineer is equal to 6 hours of labour of the agriculturist. Thus it is easy to conceive of the total number of equivalent hours of labour supplied as a function of some index number of the structure of wage rates. While following this procedure, it is not supposed that the structure of relative wage rates is determined outside the economic system or is independent of the

level of wage rates; we are simply dividing up our problems and then considering them one by one.

It is felt desirable to distinguish between two kinds of supply curves of labour in general: the supply of labour for a given population of given capacities—the short run supply of labour—and the supply of labour without such strings—the long-run supply of labour. Of the two concepts, the second clearly involves a population “theory”.

The Short-run Supply of Labour

The short-run supply of labour for all purposes is perfectly inelastic. It is that supply of labour which is available daily. But clearly, we are interested in the supply of labour for use through the market. So we are confronted with the factors that determine the fraction of the total labour power which is offered for sale on the market.

In our modern society, this function is relatively small. About 33 per cent of the total population is classified as “in the labour force”. These individuals devote in small fraction of their total time to market activities—to be more precise it might be perhaps one-fourth. This fraction too has varied greatly from time to time and country to country.

It seems that the backward bending curve about some wage rate is the most widely accepted hypothesis about the short-run supply curve of labour, as shown in the figure on next page.

Each point on this curve is to be interpreted as showing the maximum quantity offered at the given price, which is why the negatively sloped segment is said to be “backward bending” rather than “forward falling”. A variety of empirical evidence supports this conclusion. Firstly, the average number of hours a week has tended to decline owing to increase in real wage over long periods of time in advanced countries. The fraction of children in the labour market has decreased, but the fraction of women labour has increased to some extent. Such observations would produce a backward bending segment if they were regarded as being on the supply-curve over a long period of time. Additional evidence is available in underdeveloped countries, where it seems to be common experience that beyond

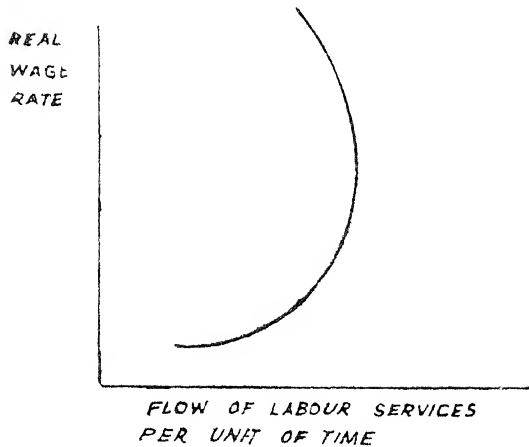


FIG 11

a fairly low level, an increase in wage rate per hour will reduce the number of hours worked. The natives act in a fashion as if they needed a certain sum of money regardless of how long they have to work for it.

The Long-run Supply of Labour

It is necessary to analyse the effect of the real wage rate on the size of the population and the qualities and skills it possesses before looking into the problem of the long-run supply of labour. In this connection a theory of population and another theory of investments in the human resources are needed. For both the theories are interrelated. Additional labour power can be produced either by increasing the number of labourers or by investing more capital in each labourer.

Let us first examine the population theory which was regarded as an essential element of economic theory where the Malthusian theory of population was a cornerstone of classical economic theory. The Malthusian doctrine treated labour as a form of capital which, like other capital can be produced at a cost; that it is produced under conditions of constant cost, the level of this constant cost being the minimum standard of living consistent with preservation. If the wage provides a standard of living above this level, marriages will tend to occur

earlier, the birth rate to rise, the death rate to fall, and the population tend to increase; and vice versa. Here the theory leads to a perfectly elastic long-run supply curve of labour as is shown in the following figure. OA is the wage rate that provides the minimum standard of living.

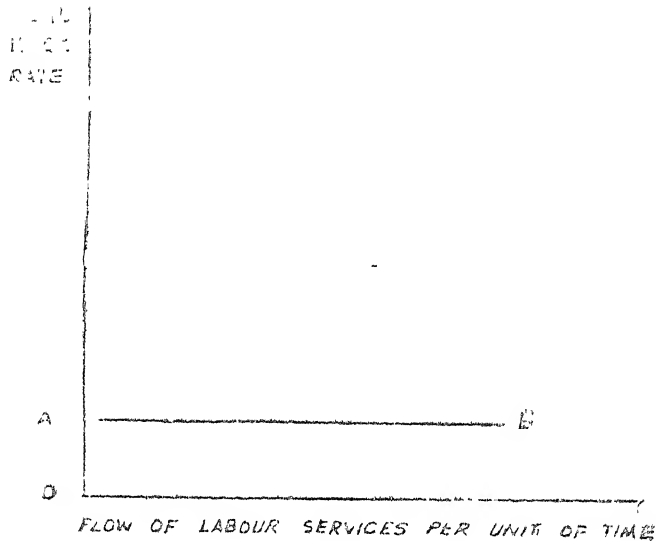


FIG. 12

Even in this crude form, the theory is consistent with much observed evidence; some has been available to Malthus and more has been experienced since his time. The Philip-pines and Puerto Rico provide some extreme examples. The United States invested a large amount of capital in the Philip-pines over the period of a half-century. As a result the population there increased by three-fold but the average standard of living remained unchanged. Similarly, the United States assisted Puerto Rico where the effect of this assistance was felt in a rapid growth in population since 1933.

One way of working for a theory of population that is consistent with experience in the Western world and at the same time is coherent with economic theory as a whole is to re-examine the Malthusian theory and interpret it in a more

sophisticated manner. We can treat the essence of the Malthusian theory as a notion that the production of human beings is to be regarded as if it were a deliberate economic choice determined by the balancing of returns and costs in place of taking it to be the existence of a technologically-determined cost of production of human beings. If so, the children have to play a dual role: they are consumption goods, a way of spending one's income to acquire satisfaction, an alternative to purchasing a T.V. set or domestic service or other goods; and they are also capital goods produced by economic activity, an alternative to producing machines or building houses etc.

The failure in the increase of population in the Western world as fast as the crude Malthusian theory suggested may have reflected simply on the rise in the costs of children relative to the return from them. There are a number of factors which may have operated in this direction: (1) The cost of raising children is obviously greater in a city than in rural areas, and economic development in the Western world involved extensive shifts to cities. (2) Returns from children as capital goods are also lower in the city than in the country, because they are thought to be less valuable at an early age. (3) The loosening family ties that came as a concomitant to industrialization made the children less valuable as a means of providing unemployment and old-age security. (4) With growing real income, the children grew more important as consumer's goods than as factor of production—that is, the services rendered by children as consumer's goods provide to be superior goods. This clearly meant sending children to school for a longer time and keeping them away from the labour market longer thus reducing the positive return to parents from children. This tendency increased the cost involved and made children more expensive relative to other consumer goods.

The people in the higher socio-economic group have a smaller number of children than in the lower one. Yet it is not clear if there is a tendency with socio-economic groups for the number of children to be lower as the income is higher. The major factor seems to be that among the higher income groups the child is likely to stay in school longer and, more importantly to get a kind of education which must be privately

paid for, whereas that for the children of lower income group is paid for publicly. Thus children become more expensive relative to other consumer goods, the higher the socio-economic class rises. These factors may not be surprising to find that the higher the income within such a class, the larger the number of children

Though the analysis cannot be regarded well established or even well defined, it seems that it provides a more promising direction in which an economic theory of population is capable of being developed.

The National Employment Policy and Forestry

There is no specific National Employment policy on an all-India basis at present. However, it is under the active consideration of the Government of India on the basis of the report prepared by the expert Committee appointed for this purpose. The strategy indicating the creation of jobs opportunities in various fields is periodically assessed before the launching of all the plan programmes. Forestry is amalgamated with the agricultural sector for assessment of employment potential. Unfortunately forestry in India does not contribute as significantly as its potentiality warrants. Agriculture, which is practised on about 50 per cent of the total land area, provides employment to 126 million people and had contributed 46 per cent to the Gross Domestic Product (at current prices in 1969-70), whereas forestry occupies about 22.87 per cent of the land area of the country and provided employment to about 3 million people and contributed only 1.6 per cent to the G.D.P¹. The potentiality of forestry has however not been fully harnessed on account of inadequate inputs and low level of funds provided for forestry development. This disparity occurs mainly owing to difference between the inputs to forestry development as compared to agriculture. While the outlay for agriculture was Rs. 23,350 million the forestry shared Rs. 911 million only during the Fourth Plan. If forests are required to play a meaningful role providing employment to a substan-

¹Estimates of National Product 1969-70 by Central Statistical Organization, Department of Statistics Cabinet Secretariat, Government of India, New Delhi.

tial segment of populace and consequently to economic growth, large resources of inputs are needed to be utilised to negate the neglect of the past and the foresters have to come out from their self imposed exile in mere conservation and think in terms of real increase in production and employment.

Employment of Staff

Table 22¹ Employment of Staff in Forest Departments as on 1.4. 1977

Designation	State	Union Ts.	Total
Professionals			
1. Chief Conservator of Forests	25	2	27
2. Additional Chief Conservator of Forests	12	—	12
3. Conservator of Forests	179	8	187
4. Deputy Conservator of Forests	851	20	871
5. Assistant Conservator of Forests	1,123	40	1,163
6. Misc. Forestry Personnel	115	11	126
7. Chief Wildlife Wardens	22	5	27
8. Others	145	7	152
Total Professionals	2,472	93	2,565
Sub-Professionals			
1. Rangers	5,960	159	6,119
2. Deputy Rangers	3,460	89	3,549
3. Foresters	20,886	362	21,248
4. Forest Guards	60,958	744	61,702
5. Forest Supervisors	3,785	28	3,813
6. Misc. Non Gazetted Forestry Staff	118,095	701	18,796
Total Sub-Professionals	113,144	2,083	115,227
Total Ministerial Staff	27,053	944	27,997
G and Total	142,669	3,120	145,789

Besides, administrative, professional and other technical and non-technical staff employed at research institutes and

¹Bulletin No. 15, Central Forestry Commission, (Forestry Statistical Cell) Miny of Agriculture, (Department of Agriculture) Government of India, New Delhi.

colleges, Dehra Dun, numbered 1,649. This number include: (i) professional staff (normally university trained); (a) 28 forestry scientists, (b) 322 other specialised scientists; (ii) 1,039 non-technical staff and (iii) 260 permanent labour force. In addition to the above, it is estimated that about 3 million¹ labourers are employed permanently in the Forest Department.

Technical Personnel

About 1,560 professional foresters are undergoing training in the various colleges and State managed forest schools.

The primary and secondary sectors forestry activities generate about 1,056 million man-days of employment.

The composition of labour force engaged in forestry is as follows :

Skilled	...	2 per cent
Semi-skilled	...	3.5 per cent
Unskilled	...	94.5 per cent

These workers have an average wage rate as follows :

Unskilled	...	Rs. 4 to 6 per day
Semi-skilled	...	Rs. 8 to 12 per day

Forest Organization

The Ministry of Agriculture and Irrigation (Department of Agriculture), Government of India, incharge of a Minister of State assisted by one or more Deputy Ministers, deals with forestry at the Centre. The Inspector General of Forests functioning under the Secretary Department of Agriculture, is also ex-officio Additional Secretary to the Government of India for forestry matters. The ministry has administrative control over the Forest Research Institute and Colleges. At the State level, government-owned forests fall within the administrative control of agriculture, revenue or even under a separate minister. The Union Minister of Food and Agriculture is the Chairman of the Central Board of Forestry, its members being the Ministers in charge of forests in the States and Union Territories, the Secretary to the Department of Agriculture and the Inspector General of Forests. This Board looks after the

¹India's Forests 1974, issued by Central Forestry Commission, New Delhi

policy and other matters at the national levels at its annual meetings.

The Inspector General of Forests and ex-officio Additional Secretary to the Government of India is assisted in technical matters by the Deputy Inspector General of Forests (1) General and (2) (Wild Life, The Secretary to the General Forestry Commission, the Director (Project Tiger), the Assistant Inspector General of Forest—(1) General, (2) Forest Industries and (3) Wildlife and the Assistant Director (Forest Statistics). Over and above there are two Technical Officers (1) Plan and (2) Industry. The Inspector General is also assisted in administrative matter by a Deputy Secretary (Forests) and an under Secretary (Forests) who controls three sections (i) Forest Institute Section (I) F R I. & Colleges Dehra Dun, (ii) Forest Institute (II) Section, P.I.S. & L.T.P., Dehra Dun. These are headed by a Section Officer who controls two to four Assistants, one or two Upper Division Clerks and about three Lower Division Clerks. The forest Development Section has also three Investigators. In addition there are six posts of stenographers.

The Forest Department in the States is headed by, a Chief Conservator of Forests who is assisted by Conservators of Forests. The Conservator of Forests is in charge of a territorial or functional circle. A state is divided into several circles. The Conservator of Forests is, in turn, assisted by Deputy Conservator of Forests, Assistant Conservator of Forests and Divisional Forest Officers in charge of a Division; Range Officers in charge of ranges; Deputy Range Officers/Foresters in charge of Sub-ranges/Sections help the Range Officers in performing their duties. The Forest Guard in charge of a beat assists the Deputy Range Officer in his duties.

The required functions generally relate to forest research working plans, Forest Utilisation, Forest Survey and Demarcation. The Chief Conservator of Forests is usually assisted by either Deputy Chief Conservators, Conservators or Deputy Conservators of Forests at the headquarters. There are Additional Chief Conservators of Forests in some States. Assistant Conservators are attached to assist the Divisional Forest Officers. The Indian Forest Service (for professional officers)

extending to all the States and Union Territories was constituted in 1966.

During the Third Plan Period special emphasis was laid on measures to meet the long-term requirements of the country and to ensure more economic and efficient utilisation of the valuable forest products. The scheme of raising fast-growing species was introduced towards the end of the Third Plan. As a result of more emphasis being placed on production from forests, the requirement of staff has increased greatly in the last 15 years or so. The following table shows comparative figures of forestry personnel in position in 1961 and 1972.

Table 23. Total Number of Forestry Personnel in position in 1961 and 1972.

Category	0961 ¹	1972 ²
Higher Professional staff- ³	975	2,267
Forest Rangers and Deputy Rangers	3,939	6,958
Foresters and Supervisors	8,837	18,189
Forest Guards	37,359	53,942
Game Keepers and others	*	12,444

It is estimated that the growth of total personnel requirement stood at 5.7 per cent compounded. However, it is felt that the relative rise in the higher professional staff was the highest which stood at 8 per cent compounded. It was at 3.4 per cent compounded among the lower cadre viz. Forest Guards. The rate of increase in the requirement of Forest Rangers and Deputy Rangers and Foresters was higher than that of Forest Guards. This is a healthy sign for forest administration. Taking into consideration all the pros & cons, the National Commission on Agriculture has projected requirement of forestry personnel in different categories as follows:—

¹One Hundred Years of Indian Forestry, Col. II: P. 278 (Table XVIII). Dehra Dun Forest Research Institute 1961.

²Progress Report 1966-72 by the Ministry of Agriculture Government of India. Prepared for the Tenth Commonwealth Forestry Conference.

³Assistant Conservators and above.

*Presumably included under "Foresters and Supervisors".

Table 24. Projected Requirement of Forestry Personnel

Category	Staff in position in 1972	Projected requirement			
		1980	1985	1990	2000
1.	2.	3.	4.	5.	6
Higher Professional Staff	2,267	3,400	4,550	6,100	11,000
Forest Rangers and Deputy Rangers	6,958	10,450	14,000	18,750	33,550
Foresters	18,189	27,350	36,600	49,000	87,700
Forest Guards	53,942	66,300	76,900	89,150	119,850
Game Keepers and others	12,444	18,700	25,050	33,500	60,000
Total	93,800	126,200	157,100	196,500	312,100

There is a long gap between the recruitment of a person and the availability of his service in the field, the educational and training facilities based on the above projections should be planned much ahead of the period when the personnel are actually needed to man the position.

According to the census of India (the Indian Standard Industrial Classification) workers were employed in the forests in India.

According to census conducted in 1971 the employment is estimated to reach 15 million people though no published data is available in this respect so far.

Estimated Employment of People on Forestry Work

Though no accurate estimates regarding the number of people living in the forests in the country are available, it can safely be assumed that almost the entire population of scheduled tribes estimated at about 38 million, dwells in the forest areas. These people are wholly or partially dependent on the employment potentiality provided by forestry operations. Assuming that nearly 35 per cent of this population is categorised to be with in the age group of 20 to 59 years and also deducting 50 percent of the women labour force, it could safely be concluded that about 10 million people could find whole time jobs on

Table 25¹. Workers Employed in the Forests

Minor Group	Description	Number of Workers		
		1971	1961	1951
120	Planting, replanting and conversion of forests	91,579	71,911	55,243
121	Felling and cutting of trees and transportation of logs	94,379	111,570	111,571
122	Production of Timber	—	8,372	—
123	Production of fuel including charcoal by exploitation of forests	28,910	82,649	25,851
124	Production of fodder by exploitation of forests	3,512	19,574	3,461
125	Production of gums, resins, lac, barks, herbs, wild fruits and leaves by exploitation of forests	10,838	45,076	75,979
126	Production and gathering of other forest products not covered above.	5,792	22,799	11,106
Total		235,110	361,951	283,211

forestry operations. At present the estimated employment in forestry is about 3 million people who are fully employed in this field. In addition, about 5 million people find their living on forestry operations either part time or casual employment basis. Such people are employed in transportation and movement of timber and also processing industries. These people are not entirely from the forest dwelling population.

Forestry labour is usually divided into three different heads viz., (1) Forest Management, (2) Forest Extraction and (3) Forest Industries.

(1) *Forest Management*:— Since a major part of forests is controlled by the Forest Department in the States and Union Territories, the labour force engaged under this head either permanently or partly, is under public employment. Nearly 1/5th of the total employment under forestry is commanded by this head. The conditions of employment of labour is much better under this head than the others.

¹Census of India 1961, Vol. I—Part II B (ii) General Economic Tables.

(2) *Forest Extraction* — Extraction work is usually done by private contractors who employ the labour force for felling and extraction of timber from the forest. These workers get their rations from the shops kept by the contractor at a higher price than the usual and pays them wages at lower rates. Thus they are cheated in two ways. The workers included under this category form 3/5th of the total working force in forestry operations.

(3) *Forest Industry*:—The industry is usually in the private sector. The residual 1/5th of the labour force is employed in the industry. The labour in the industry is more or less organised or rather it is better organised than that which is employed in extraction work.

The forest labour can be divided into three categories¹ as follows:—

- (1) Local Labour
- (2) Imported labour and
- (3) Labour from forest villages or settlements.

(1) Local labour is that which is recruited now and then by the local forest subordinates from the surrounding villages. This type of labour is often employed regularly every year in making forest roads, clearing firelines and for departmental burning. Unskilled or semi-skilled labour needed for these ordinary jobs is usually available in abundance throughout the year. But during the agricultural operations such labour become scarce. The wages paid to such labour vary from Rs. 3/- to Rs. 3.50 per day. During harvesting and weeding seasons, they even reach Rs. 7/- per day.

(2) Imported labour is that which is brought into the forests for one or more year's work. After the seasonal work is over, such labour returns home. For example, the sawers from Delhi, Rohtak and Himachal Pradesh etc. go to work in the forests of Uttar Pradesh. Labour from these places is slightly costlier than that imported from less distant places like district Saharanpur. This is because the former demand higher wages and at least one way rail or road fare from their homes to the place of work. This labour which is comparatively

¹Sharma L.C. "The Forest Industry in Uttar Pradesh" 1972, pp 132

costlier, finds work in the forests on two counts viz. (1) paucity of labour (2) efficient working.

(3) Labour in the forest settlements or villages is more or less permanent. Such labour is usually located at selected centres in or near the forests. This kind of labour settlement is known as "Taungya" or "agri-silvi" system. This system resembles the shamba system of afforestation in Kenya¹ which is coming to an end there now. The settlers of a "Taungya" are to look after newly planted trees in the forests. This system of raising tree crop in conjunction with agricultural crop is now being practised in such tracts to help the landless labour. The settlers get a plot of land to cultivate free or on nominal rent on the understanding that they shall sow seeds of the specified forest species along with the third agricultural crop. They then continue to sow their crops for two or three years and get another plot for sowing when trees get stronger and need no protection. This system enables the Forest Department to be carefree over the rearing of trees in the forests. The Forests Department would have to appoint many forest guards and other labour force just to look after the newly planted trees in the forests in the absence of such forest dwellers. It would mean a heavy expenditure on the exchequer.

The labour system adopted in the forests is one of the following types:

- (1) Daily labour
- (ii) Piece-work labour
- (iii) Contract labour
- (i) Daily labour is engaged on ordinary forest work, viz. weeding, planting and construction of roads, clearance of firelines and for departmental burning etc. Daily labour is recruited locally by the subordinate forest officers. Fluctuation in the market trends effect their wages very much. For example, the labourer will demand higher wages during the harvesting season but he may accept low wages during the off season.
- (ii) Piece-work labour is often used for departmental timber operations, viz. extraction of timber for local

¹Johnston, D R., A.J. Grayson, R.T. Bradley, "Forest Planning" Feber & Feber, London 1967.

use. Sometimes it is also used for construction of roads. Usually a standard specification is fixed for the conversion of timber which must be maintained before the piece-work is passed for payment. Diameter or girth of the tree is the criterion for felling trees on piece-work. Collection of seeds is paid for per unit of seed collected. Labour is usually employed on piece-work for construction of buildings and roads.

- (iii) Contract labour needs constant supervision and need to see that the work done is up to the mark and conforms to the terms of reference of the contract. This is necessary because the contractors might indulge in mal-practices; at the same time some supervisors may also turn dishonest to accept illegal gratification from the contractors for passing their work for payment.

People in the Forest Regions and their Life Patterns

Most of the people dwelling in and around the forest regions are usually agriculturists. They have extremely small and uneconomic land holdings. With the increase in the population in geometrical progression during the last two decades, the number of landless agriculturists must have increased. The land can hardly sustain the people to provide adequate livelihood as the holdings are small and the means of the agriculturists and agricultural practices remain still primitive. Thus these people are forced to find employment in forestry when there is no work in their fields. Therefore there is shortage of labour when both the raising of agricultural crops and planting of trees is involved at the same time.

The forest dwellers practise shifting cultivation in some hilly areas in the north as well as in the eastern parts of the country. Now these people are being advised to wean away from this destructive method of agriculture. The "Taungya" or "agri-silvi" system of raising tree crop along with agricultural crop is being practised in some parts of the country to help the landless labourers. Cattle grazing is another major occupation followed by the forest dwellers. Professional shepherds

live mainly on grazing of their cattle in the forest area. Most forest dwellers keep cattle both for milk and dung production. Cattle population has increased beyond the carrying capacity of the forest area because of free and unregulated grazing permitted in the forests. In the past fishing and hunting provided some livelihood for the forest dwellers but with the depletion of the wild life it may now be considered more of a favourite pastime of some of the forest dwellers rather than a means of livelihood

Manpower Planning in Forestry Development

The growing similarities between communist countries and the capitalist economies have created naive surprise among the political commentators in recent years. Anyhow it appears true that the centrally-planned and the traditionally unplanned economies have something to learn from the followers of each others' faith. One feature of the socio-economic convergence is the emphasis which the post-war western world (and the developing countries within its sphere of influence) now place on national economic planning in resource development. Once people were scared of the concept of "planning" thinking that it was unjustified curtailment of individual liberty but today the economic and political awakening accept this system universally.

Planning aims at optimal utilisation of resources to serve social, economic and/or political ends which are usually determined at the political level. Planning tries to select the most suitable 'means' to attain the desired 'objectives'. In a nutshell, it involves making a choice among several courses of action. Generally, planning poses problems which are of a special nature in forestry, and mainly so in large forest enterprises. The long life span of trees, the geographical extent of forest estates and the uncertainties of nature and markets create these problems in general.

Planning may mean to describe anything from a series of arbitrary or dogmatic decisions to a critical and sophisticated investigations into the whole range of possible choices open to an enterprise. Planning implies the collection of data and assembly of data to begin with. Then follows the stage of

examination and testing against the appropriate criterion of the various possible courses of action and finally the formulation of plans. The influence of economic and political forces, wind, weather, disease and fire, natural forests and man-made plantations are liable to changes which affect their productivity, operational techniques, their profitability and even long-term objectives. Since forestry is a long-term venture, it is out of question to manage it on a day-to-day basis. Present decisions are likely to influence the forest for a long time to come. Therefore, both continuity and elasticity should be kept in equilibrium while planning for forestry projects. Fundamental objectives should not be allowed to fluctuate with every new and not necessarily stable situation. Forestry needs very general plans testifying long-term objectives. These should be revised only when circumstances change permanently. An annual plan, itself forming the basis of annual financial budgets or estimates, sets out the programme necessary for the implementation of the aims of the plan.

Elasticity in planning is necessary because of complexity of environments. However, success of such plans depends on the reliability and experience of the staff. A detailed plan written by an experienced officer is always better in case the circumstances are otherwise.

Forestry and Planning of Labour

Planning for afforestation, exploitation and the building up of transport system in forestry sector is usually done in so many countries but the problem of proper utilisation of human resources and creation of employment for them hardly receives any attention. It is often taken for granted that labour will be available from amongst the unemployed and under-employed for new development in forestry and hence there is no need to provide for an adequate supply of suitable labour force. An appropriate place should, however, be allotted to the planning of labour force for forestry development.

Acute social and economic strains are liable to occur if plans do not pay proper attention to the need for jobs. This is likely to result in unpopular support for carrying out a plan. It is necessary to maintain a satisfactory level of employment

to make plan a success. An aspect of manpower problems widely acknowledged is that there should be no shortage of workers having the required skills. Training of workers necessarily requires resources. If the plan allocates all the available resources to material investment, nothing will be left for training of personnel. the allocation of resources should be made on the basis of alternative uses. Such allocations must keep allowance for training expenses. As a result the training of personnel need not only be planned and provided for but also be costed for optimal choices. The development plan which does not include the human resources, ignores an important factor of production. A major source for economic growth is left untapped in this process. Therefore the problem of manpower planning is an important ingredient at each step of forestry planning.

Broadly speaking, the common factors of production are divided into three artificial sub-divisions. In fact there is no definite and uniform measuring rod for assessing labour, capital and land distinctly. Great deal of variation exists within these classes and under many cases they overlap and thus it becomes difficult to decide to which class a particular factor belongs. We can talk of substituting units of labour for units of capital in a simplified theory and also adding additional units of labour to the total input as though this were similar to spending ten rupees more, but there is great complexity of adjustment of inputs specially in respect of labour services in real life. The following pages mainly explain some complications of using labour as a productive factor in forestry.

Social and Economic Development

Formerly foresters were devoted to the planning and management of their crops at the cost of labour force which was neglected altogether. But now the time has come when they have begun to realise that men pose problems more than trees—the problems which are often more urgent.

Many countries in the world are passing through a period of rapid development viz. social and economic. Wages are rising sharply in some more developed countries. This phenomenon gave rise to the decay of several flourishing industries which were unable to pay high wages. The reason for the

rapid increase in income and standard of living is greatly increased productivity per man which is consequential to the use of various forms of machinery. In case the mechanisation in a certain task is impossible, the alternatives are either to do away with it or to pay higher emoluments for it. For example, domestic servants have almost disappeared in the economically more advanced countries during the past few decades. It is because few people are in a position to pay them high wages comparable with those they can earn in the industry. Although housewives are able to manage their own houses with the help of various mechanical devices successfully, they have so far failed on the front at cutting their husbands' hair. As a result the cost of a hair cut, with no success in automation, compares favourably with the increase in barbers' wages. This condition has not come to India so far but it has begun to show its fangs. Industrialisation of the country is attracting a sizeable part of the rural population towards cities and the concentration of industrial complexes in the country. This is causing shortage of domestic servants and also the increased wages. Workers in the fields are demanding higher wages even sometimes they are reluctant to take up arduous jobs. Another thing is that increased prosperity also brings with it an ambition for higher social status which is commonly identified with a career providing progressive rise in income throughout the life.

Mechanisation in forestry work and the training and social conditions of the workers is taken up in the world because forestry involves hard manual work in remote places with a possibility of yielding a product having low value and hence sensitive to cost increase. Mechanisation increases labour productivity to a great extent and at the same time enhances the status of the forest workers. It also increases the skill and experience which is always better than the sheer muscular strength. It is a social problem in forestry that a strong youth is capable of earning much more than his father doing the same job. The earning power of a worker diminishes after the age nearing forty-five years although it is true that he gains more experience and knowledge. Perhaps the older man is found more reliable and matured in judgement than those of his juniors. Increasing mechanisation requiring

more skill and experience compensate to a large extent for physical strength. A young man and an old man having physical fitness can both handle a complicated machine with equal efficiency. The problems of forest labour are varied which do not come to an end with the worker himself. In this regard his wife and family have also to be considered. Usually the wives do not like to live in isolated communities. The sons and daughters of the forest workers have to be provided with the opportunity for training and for employment after they have completed their education. With these needs in view many countries of the world have created large, well-planned forest communities, for example, Canada, Russia, New Zealand etc. Such amenities for forest workers are absent in India.

Manpower Trends in Developing Countries

Developing countries need more work in forestry and consequently more labour force is liable to be required there. At the same time it is very essential to find employment for large segment of the unemployed rural population, it is often difficult if not impossible for these countries to adopt the capital-intensive and labour-saving devices already patronised by the advanced countries except with foreign aid.

Labour-Intensive versus Capital-Intensive Forestry

Since capital is scarce in the developing countries and it is needed for all developmental activities, there is a clear need to save it as much as possible and employ it elsewhere it is needed the most. Therefore labour-intensive devices in forestry should be allowed to be pursued specially in those countries where provision of employment is a problem, viz. India. But labour-intensive approaches cannot always have an edge over capital-intensive ones under all circumstance¹. For this purpose individual models of development, especially their manpower components, should be thoroughly studied. Labour-intensive approaches have the advantages of including demand by expanding the volume of income for large segment of the active population.

¹Peter Sertorius and Hans Henle, *Forestry and Economic Development*, 1978.

In such cases, the field of forestry provides the proper ground to find a favourable answer because a number of operations can be carried out manually, depending on the prevailing situation as regards topography, size of trees, transport facilities and distances. In fact many silvicultural functions can easily be performed manually. In advanced countries such functions are mechanised because of the slow-growing labour force which is not sufficient to cope with the situation. Thus for developing countries manual forest work does not mean the renunciation to more ambitious progress, but, on the contrary, it means a situation conducive to creation of employment. The limiting of mechanisation is, however, completely different from primitive working methods. In non-mechanised work, increase in productivity, safety and the saving of energy can be achieved by improvements in working methods, in tools and their maintenance. Developing countries should give first priority to effecting such improvements. Mechanisation should be introduced only where terrain and exceptional sizes of logs make manual labour too strenuous and transport impossible. Under other conditions, skilled manual labour using draught animals may hold its own in competition with mechanisation, so long as wage levels remain what they are now.

Growing of timber other than harvesting, employs relatively small number of workers. This is mainly because most of our forests are not under active management. On the other hand mechanisation has not been able to progress well in respect of forest management operations as it has spread in many other productive activities in the world. Silvicultural operations are performed with the hand tools alone in the world. Planting and cleaning also is done manually. The growing of timber is a labour-intensive process. Further more the mechanisation is the device to reduce both the demand of labour and drudgery from this work. Anyhow the very nature of timber growing is such that automation is not possible to the extent it is introduced in the factories. For such a purpose the machines used must be mobile, rugged, and fairly simple because of geographical extent of forests. Keeping this aspect in view they will require usually a large number of operators. All the

above indicates that intensive growing of timber on a large scale, is likely to require the services of many labourers.

Trained Manpower Requirements in Forestry in Relation to some Previous Approaches

It is true that many pages have been devoted towards education and training development in forestry and much has been written on the subject of training levels and curricula than the numerical requirements of personnel. Approximate projections have always been made for developing countries on the basis of existing staffing pattern in relation to forest area and then adopting empirical ratios of trained staff per unit area of forest. For example, Glesinger discussed policy implications in 1961 concerning education in forestry in Africa, the Near East, the Asia Pacific region and Latin America. He based requirements for Africa taking into consideration the existing ratios of professional and technical level personnel to forest areas in Kenya (1 professional per 60,000 hectares and 1 technician per 25,000 hectares of accessible forest). Glesingers' paper was one of the first papers in this field. On the other hand in view of virtual absence of data to base projections, it is a very good attempt to provide a quantitative assessment of educational and training requirements in forestry.

Figures of "1 professional forester", for 2,000 hectares with "a district forest officer to every 10,000 hectares" have been suggested in an FAO publication (CIDAC. KUW, 1966) for forestry development in the Arab countries.

In the Asia-Pacific region, a ratio of 1 professional to 5 technical level staff has been postulated (see APFC, 1964), though no formal attempts have been made to assess numerical requirements, except specifically for pulp and paper industries.

Trained Manpower Requirements—Features Influencing The Methodology for Forestry Sub-sector

The case of forestry is altogether a different one. It is a component of many sectors—rural, industrial and the services categories. Westoby (1965) has pointed out that in developing economies ".....forestry and the forest industries assume a particular significance. At the one end they reach back into

the rural economy; at the other they penetrate into many branches of the industrial sector", when the protective and social roles of forestry are considered (Water conservation, wild life management, the provision of recreation, the relief of unemployment, etc.) the pervasiveness of forestry into many economic sub-sectors emphasises the difficulty of adopting any one traditional method of educational planning.

Over and above it becomes extremely difficult to integrate manpower planning with that of national economic planning as it has a wide range in capital/labour ratios which is a general feature of forestry and the forest-based industries. This sub-sector is labour-intensive at the rural end in the establishment and management of forests, while in respect of industrial sector it is quite the other way. For example, there are very few industries which are more capital-intensive than that of a modern paper mill. There are big differences within the industrial sector. Saw-milling is counted as a cottage industry in many countries while a fully automated fibre-board plant is counted as capital-intensive operation. Inclusion of non-revenue producing forest resources management viz., protection forests, makes it more complex than a simple relationship between the forestry sub-sector and a measure of the aggregate production function.

It must be remembered that forestry development does not necessarily mean economic development. It is just possible that in some developed economies the forestry may be in an undeveloped stage. Similarly a highly developed forest economy can exist in an underdeveloped country.

The long-term nature of forestry in comparison with many other activities that compete with it for investment priority, needs no stressing. Long-term planning is advantageous to foresters for their exercises but the investment in forestry both of finance and manpower cannot promise quick results. Therefore, forestry is likely to suffer more than most industries in time of financial stringency. Again the developing economies need flexible manpower planning as the allocation of capital in such economies is done on the basis of getting quick results which are not cared for in developed economies.

Another aspect of long-term nature of production in forestry is that their location is pre-determined. In the first instance every country has its forest resources but wherever further resources are needed to be created, their location is determined on the physical and biological environment. Forests are immovable assets and thus their management is greatly influenced by the local environment. The impact of this fact on manpower requirements and on planning is, perhaps, greater than in many other fields. For example, barring the industrial sector, parameters of management intensity chosen for any particular set of conditions cannot be applied elsewhere without significant modification.

Finally, manpower planning in forestry usually depends on the changes in the traditional concepts, policies and practices which are currently in vogue both in developed and developing economies. The function of the present-day forester is not clear-cut in the world. According to latest thinking both in Europe and America there is need of re-appraising the traditional notion of the forester as simply a land manager. This definition is thought to be inadequate. The forestry education is being rationalised by putting more emphasis on technical education than the biological aspect. The importance of economics has begun receiving more attention than the lip-service from high-level administrator.

Manpower Planning in Forestry—the Requirements of a Methodology

In the context of discussions above the criterion underlying a proposed planning methodology for assessing manpower and training requirements in forestry development planning can be summarised as follows:—

1. Any methodology must have realistic foundation for forestry development plan having at least production goals for a period of 20 years ahead.
2. Any methodology must be flexible because of uncertainties involved in projecting the long-term requirements and the differing objectives of forest policies.
3. It must contain simplicity and it must be able to be geared to date which is either readily available or can

be easily obtained. Every country must have access to historical operational costs which are labour-intensive reflecting the cost of labour requirements.

Briefly the methodology should provide a working tool which allows to establish a quantitative and qualitative requirements for trained personnel at all levels for any country or region. It must take into consideration development of forestry and other environments such as economic, social and physical.

The Forestry and the Principles of a Methodology

The methodology for projecting trained manpower requirements in forestry development planning deals primarily with three aspects of training—vocational, technical and professional. Such training fulfills the demand for operational field of forestry, forest industries, and to some extent such as clerical and specialist servicing.

Vocational : It is a training imparted to men who are concerned with manual labour for less than six months as adhoc short-course training. Such persons are later on liable to be promoted to the upper ranks from the labour force. Such men are fit for holding a variety of ranks in the different forestry services in the world. For example, a vocationally trained employee is usually termed as "Foreman", "Forest Guard", or "Forester" in the English-speaking African Service. Such people are called "Forest Guard" and "Foresters" in India.

Technical: Technician is a man who has undergone formal full-time training, usually for a period of one or two years, in a recognised institution at the sub-professional level. He is capable of organizing and supervising work in forests and industrial plants and of carrying out the instructions of professional foresters, administrators, plan overseers and research officers. He may be described as "Technical Officer", "Forester", "Forest Ranger", or "Forest Assistant". He differs in extent and depth of training and also the variety of task he performs, all these technically trained employees are regarded as forming a single category.

Professional: Professional is a man who has completed a minimum years of fulltime study or its equivalent after

graduation. He is oriented to forestry and related disciplines though it is not a must. Thus, graduates in pure science and in specialised fields who may be employed in forestry and its allied industries (e.g. zoologists, chemists, economists, civil engineers, etc.) are all included but not members of the non-graduate professions such as accountancy. The professional denominations of the forestry services are as different as the technical: "Forest Officer", "Forester", "Assistant Conservator", "Scientist", and "Research Officer" are commonly found in English-speaking countries. They are the men who are capable of framing the policy or planning as a whole or in part the working of a forest area and, at the highest level, of the national forests of a country or of a specific forest or wood-using industry, or even all the forest product industries of a country, including, after proper specialisation if necessary, planning and research of all kinds for the promotion of silviculture, and on methods employed by the lumbering and wood-using industries".

Thus, the terms vocational, technical and professional, refer primarily to levels of training, rather than to types of training or kinds of employment.

The Type of Work in Forestry

Forestry jobs have certain special characteristics which make them less desirable comparatively than many other types of employment. These jobs involve harder and arduous physical work than many other jobs. The work is usually performed by hand in the open. Forestry activity specially in the cultural and harvesting stages, is of a rugged and physical nature similar to that of agriculture and heavy construction. Forestry work is often performed in the roughest of terrains, in steep and rocky mountainous country, in swamps, and in areas of heavy brush. Furthermore this work continues in the extremes of heat and cold.

There are good and bad points involved in the work. The logger undoubtedly envies the snug factory worker at his machine during bad weather but he is definitely glad that he is not confined within factory walls during fine weather. Many people prefer physical jobs in the open over sedentary work at the desk.

CHAPTER 9

Capital In Forestry

Capital is one of the most controversial topics in economics. It is not natural but a physical or rather say man-made agent of production. Some economists, like Fisher, argue for a broader and more logical concept. According to them capital is correlative of income. Capital consists of goods which provide us with income. But money income is merely a proximate fact. The real income is hidden behind money income. It consists of utility which a person derives from the consumption of a certain commodity. Capital is the cultural resource of a forester as distinct from its human resources (labour) and natural resources (land). It is difficult to draw a hard and fast line between land and capital. They cannot be kept in water-tight compartments, since in many economic analyses, they are treated as if they were the similar types of productive factors. However, land being so important in forestry production, it is essential to discuss it separately.

The term 'capital' as used here means produced goods which are not immediately transferred to an ultimate consumer for his use. In forest management, 'capital' means growing stock—timber and wildlife as well, and also other productive living things that man may cultivate. It includes equipment of forest production also such as roads, bridges, rolling stock, installations for forest production, recreation, and watershed management; buildings and other structures, machines, tools and other supplies.

In logging, capital means such things as trees and logs (goods in process of production), machinery, roads and equipment. The goods in process and the facilities created by man, equipment, and all those materials which are used for increasing further production of other goods are termed as capital in transportation, in manufacturing and in marketing.

Finally, the working capital, means money which is used to meet the expenses in respect of pay rolls, for making

payments for raw materials etc. Such money is additional capital over and above the capital goods.

Capital and labour, the two factors of production differ very much in character. The entrepreneur can buy capital outright or hire its services while he cannot buy but hire the service of labour only. Possibly he cannot possess the source of any services of labour except his own. In case of capital both buying the capital or hiring its services is possible. The entrepreneur may be interested in the productiveness of labour only. Capital can be used in two different forms (i) productive tools and (ii) goods in process. In the first place, it is a productive tool, such as a chain saw. When the entrepreneur uses the capital in the form of tools he utilises their services irrespective of whether he owns them or hires them. In the second place the capital is in the form of goods in process, e.g. stacks of sleepers in the yard of a miller for converting them into different forms of scantlings, planks etc. Thus it is in the form of raw-material partially processed goods which may be converted into the production process.

Capital as a factor of production has no uniformity. For example, for ply logs it is used in the form of trees, saws, trucks, logs for manufacturing ply, tally sheets etc. All these heterogeneous mass of productive factors may be added together, through the measuring rod of money. Thus the foresters may talk of investing Rs. 50 lakhs in logging operations or devoting Rs. 100 lakhs to tree planting. It is important to note that actual inputs in production are never used in monetary terms of money. The services rendered by 5 chain saws cannot be equal to those rendered by two trucks though the money value of the capital equipment in both cases may be the same.

Peculiarities of Timber Capital

Forest capital possesses some peculiarities. Since foresters are chiefly interested in forest capital we are going mainly to discuss here timber only.

The first peculiarity of forest capital is that the timber product is at the same time the timber growing machine but it is amazing to note that finally the machine becomes the product.

It is the main feature of forestry whose consequences pervade the forest management.

A long gestation period involved in forestry is the second peculiarity of forest capital. The long period between the decision to produce and the maturing of final produce for harvesting is sometimes 100 years or even more. The market for timber supplies, forestry costs, and technology—all change during such a long time. Thus a long period enhances the chances of loss and risk. The future is not certain. In industrial circles twenty years is about the reasonable limit of investment planning and after that the position is too indefinite to consider. But the forester may just be getting well started in twenty years. According to Zivnуска¹ the actual production of wood (annual growth or increment of forests) cannot be adjusted to the short-run requirements of the market. A study of the market during the last few years may indicate a reduction in the production of wood. The right step is to reduce the growing stock with every decline in demand and vice versa.

The third peculiarity of forest capital is its long period of maturity which gives rise to modest rate of return in forestry. Although the rate of return is presumably the central theme in respect of commercial forestry, there is absolutely no data available from India on this vital issue. What to say of data, commercial forestry has yet to start in this country. Whatever little data occurs indicates that Himalayan pines, teak and sal (*Shorea robusta*) provide the highest rate of return. All the other woods generally yield lower rates.

The fourth peculiarity of forest capital is that it usually dominates the cost of timber growing among the variable costs. Suppose the foresters leave the trees untended under the nature for growing trees. In this case the cost of holding the forest capital, or timber-growing stock, may be nearly 100 percent of the variable costs. Now take the example of an extreme case where the foresters play an active role in silvicultural operations etc., the cost of timber growing may overshadow the other kinds of capital and of labour. Timber growing is a unique thing among the industries as the great proportion of its costs are absorbed into capital plant.

¹Zivnуска, J. A., 1949. Some aspects of the economic theory of forestry. *Land Economics*, 25 (2): 165-72

The fifth peculiarity of forest capital is its versatile nature. Some kinds of capital are highly versatile because they are capable of being shifted to some other investment position if found unfit in one. Money is the highly versatile capital. Iron and petroleum are other examples of such capital. An electrical motor is another example among machines. On the other hand some capitals are less versatile than others. For example a saw can only be used to cut wood or a pulp mill can prepare pulp alone. If capital cannot be readily shifted, its value is bound to decline heavily in case the prospective demands for its product diminishes. Forest capital seems to be fairly versatile. It possesses high "time versatility", since it can be shifted either now or some time later due to its durability.

The above peculiarities are, no doubt, special features of forestry. But it should be remembered that forest growing stock is not all the capital needed for producing timber. The other kinds of capital—machines, seed, nurseries, pesticides etc.—are also equally good. Moreover, the long period of production seems to be gradually shortening with the new fast growing trees coming to the field. With shorter rotations the proportion of non timber capital is increasing in the "factory".

The special features of forestry bind the forester to maintain the inventory of wood which is much larger than in other enterprises. The forest capital and its product are by nature such that the inventory can be run down rather easily when demand is high while the cost of holding the inventory is high when the demand is low as trees do not deteriorate on the stump easily.

Types of Capital

Capital in use in forestry can be divided into different categories as follows:

Capital may be liquid or frozen. The distinction between the two categories of capital lies in the relative ease with which they can be converted into some other goods or services. Money through which conversion takes place, is the most liquid form of capital. The other liquid forms of capital are government bonds. Though conversion of finished timber into money is a little difficult, yet it is another liquid asset. A

logging road or a forest rest house is frozen capital. These cannot be converted into money easily. If it can be converted to money, it will have to be done at a great loss. A new plantation and a stand of mature timber are both frozen capitals. They differ only in degree, the later may be thawed out more easily than the seedling stand. But again it is very difficult to keep them in water-tight compartments since there is a wide range of liquid and frozen state of capitals. Some forms of capitals lie on the borderline. Even then it is useful to say that a man with Rs. 1 lakh worth of capital in the shape of saving accounts and government bonds is in a much better commanding position with regard to productive decision than that who possesses an equal amount worth of capital in the form of land, roads and growing stock.

Again capital is divided into two—fixed and working—for the sake of convenience. If the forester has to play a meaningful role in sustained yield production, he must have growing stock, roads, buildings and machinery—all of which are regarded fixed capital. But the forester is not in a better position as long as he does not have some liquid capital with which he is able to pay wages, interest, bills, rent and defray other current costs. A successful forester usually meets these expenses out of current revenues. But the sale proceeds may come in only at monthly intervals while wages are needed to be paid weekly. The forester must pay immediately without delay to run his business smoothly. If he has to start production or to expand his venture, he needs the working capital definitely. It depends on the type of production as to what period it will take to get him the revenue. For example fuelwood will get him revenue immediately. But sawnwood such as scantlings or sleepers will take more than six months or so while in the case of plywood it might take about two years. A large pulp and paper mill may need several years to reach the same stage.

Forestry is endowed with a special feature. The working capital comprises a small portion of the total capital involved in most forestry enterprises, but it is very important for a successful venture. The forester has to carry out protection measures, cultural operations and silvicultural treatment regularly according to schedule in the young growing stock regardless

of harvesting situation. He cannot postpone these operations even for one season in the face of crisis in the current revenue. Working capital is so important that the forester is handicapped in making his management flexible without it in hand. A temporary slump in prices does not hamper the forester to sell his mature stock for earning revenue to defray current expenses. For this reason the forester will try to keep some of his capital in liquid form such as bank account or government bonds—ready cash for unforeseen circumstances.

Often the importance of working capital is underestimated. The forest contractor may have enough money to buy all the milling and logging equipment he needs for a lumber business. Still he will require liquid cash to buy stumpage, to make payment to his crew and other supplies for several months before he actually begins to receive enough revenue to cope with the situation. If he lacks working capital funds to start with, the creditors may force close on him before he ever starts his business in full swing.

Working capital plays an important role in a timber-growing venture. Suppose the forester has to reafforest a degraded piece of forest land. In this case he knows that it will take him about fifty years to grow these trees to saw-timber size. He also knows that it is his dead investment for that time. Instead he will have to defray expenses on protection, silvicultural operations etc. from his liquid capital in hand during the whole production period. If the forester has to afforest 100 hectares with trees which cost him 2 Rs. thousand per hectare for planting, the total amount involved in planting will be Rs. 2 lakh. But again he will need some amount for maintenance of the plantation till it reaches maturity. This will be the working capital. Assume that he needs Rs. 20 per hectare per year. The total working capital necessary will be of the order of Rs. 10 thousand for 5 years.

Capital in Forestry Production in India

The geographical area of India is 328,778 thousand hectares. The forests covered 74,875 thousand hectares or 22.77 per cent of the total geographical area of the country in

1973-74.* However, it is a fact that no details are available in respect of forest area comprising 788 thousand hectares.

The main feature of Indian forests is that a major portion, viz. 91.75 per cent is under the charge of Forest Department. Again Civil Authorities control nearly 3.25 per cent forest area. Nearly 2.94 per cent is under the charge of Corporate bodies and the rest 1.83 per cent is in charge of private Individuals. Public ownership of forests is of key importance in India.

Table-26. Ownership of Forest Lands in India.
(’000 Hectares)

Ownership	Forest lands	Percentage
1. Forest Department	68,150	91.98
2. Civil Authorities	2,409	3.25
3. Corporate Bodies	2,182	2.94
4. Private Individuals	1,345	1.83
All Ownerships	74,086	100.0

Of the total forest area about 17,310 thousand hectares have good stock (density 0.70 to 1.00), about 25,175 thousand hectares have medium stock (density 0.40 to 0.69) and poor stock (density 0.10 to 0.39) and about 2,712 thousand hectares have very poor stocks (density less than 0.10). Thus the total area in use is about 45,197 hectares. Bamboos comprise an area of 10,000 hectares while the stock of about 10,000 hectares is variable because of their location in hilly and mountaneous tracts which is mostly managed as protection reserves banning exploitation beyond the removal of dead and dying trees.

The coniferous forests cover about 3,704 thousand hectares or 5 per cent of the total forest area. These forests extend from Kashmir to Assam, covering the entire Himalayan ranges. Some important coniferous species are deodar (*Cedrus deodara*), chir (*Pinus roxburghii*), blue pine (*Pinus wallichiana*), khasi pine (*Pinus khasya*), spruce (*Picea smithiana* and *Picea spinulosa*) while the less important coniferous species are firs

*Forestry in India, 1973-74--Summary Table issued by Director of Economics, Ministry of Agriculture and Irrigation, Government of India, 1977.

(*Abies pindrow* and *Abies spectabilis*). The broad-leaf forests cover 70,383 thousand hectares and consist of 9,700 thousand hectares of sal (*Shorea robusta*), 9,100 thousand hectares of teak (*Tectona grandis*) and 51,583 thousand hectares of other woods. Of these timber trees teak, sal, rose wood (*Dalbergia latifolia*), Indian laurel (*Terminalia tomentosa*) shisham (*Dalbergia sissoo*), gurjan (*Dipterocarpus* species), padauk (*Pterocarpus dalbergioides*), benteak (*Lagerstroemia lanceolata*) surpass other in quality and importance. Teak is found mainly in Kerala, Tamil Nadu, Karnataka, Madhya Pradesh and Gujarat. Sal occurs in Assam, Bihar, Orissa, Tripura, Uttar Pradesh, West Bengal and parts of Madhya Pradesh. Sandal wood trees (*Santalum album*) are found in the dry deciduous forests of Andhra Pradesh, Karnataka and Tamil Nadu.

The forests in India face a major problem that no inventory in a right way has been prepared so far. In the Himalayan ranges, it becomes very difficult to exploit the matured stock owing to lack of communications there. The growing stock in the forests is not known correctly. The gross annual increment of growth in forestry is 33.27 million cubic metres.¹ However, it is believed that the increment is not less than 60 to 70 million cubic metres.² Since no systematic survey of forest resources has been conducted so far, these figures are anybody's guess. The computation of increment in different forest areas specially by main species and its correlation with the annual cut are regarded as the basis for a proper forest management. Today India lacks this information to a greater extent.

Growing Stock

The total growing stock (excluding protection forests) was estimated at 412 million cubic metres of coniferous species and 2,212 million cubic metres of broad-leaf species. These quantities represented trees of saw timber size. Thus it is clear that the rough inventory was confined to the trees having a diameter of 20 cm and above. Such an inventory left out a sizeable quantity of growing stock which can be utilised for the manu-

¹As compiled at the time of Commonwealth Forestry Conference 1968.

²Report of the Task Force on Forest Resources Survey, Planning Commission, 1972.

facture of pulp or as fire wood. This is quite a big chunk of growing stock which has been left over unaccounted for.

Annual Growing Increment

The annual growing increment is the most important in respect of supply of raw material. The annual allowable cut is decided in such a fashion that the capital stock of the forest does not deplete. The gross annual increment was estimated at 44.7 million cubic metres in 1964-65. It excluded the protection forests where no felling is permitted except removing some dead trees. A net growth of 42.2 million cubic metres was assessed after providing for losses under unavoidable circumstances. This included 3.05 million cubic metres comprising coniferous species. Of this the total quantity available for industrial or commercial uses was 32.2 million cubic metres including 2.3 million cubic metres of conifers.

Generally, the annual allowable cut has been held at 10 per cent below the net annual growth in India. On this basis, the allowable cut in commercial forests was 29.0 million cubic metres in 1964-65 but actually the fellings were kept as low as 21.8 million cubic metres including 1.50 million cubic metres of coniferous species.

The harvesting, processing and distribution stages of forestry are handled almost entirely by private enterprise. The activity of the Forest Department in these stages is pretty much limited. The recreational activities in the forests are entirely provided by the Forest Department—in a way as monopoly.

Very little was known about the volume of different types of species available in Indian forests until the Pre-investment Survey of Forest Resources was initiated by the Government of India, the Food and Agriculture Organisation and the Development Programme of the United Nations in 1963. This survey covered in details using modern appraisal techniques in three separate zones located in Northern, Central and Southern India. According to the survey greatly increased cuts of sawlogs including teak and sal wood would be available from the Central zone. In addition the bamboo could be harvested in large quantities annually. The growing stock is estimated at 110 million cubic metres in the Southern zone. It also

contains an estimated quantity of 1.2 million tonnes (air dry) of bamboos and 5 million tonnes (air dry) of reeds. Thus the quantities of wood available, according to the Pre-investment Survey of Forest Resource survey reports for commercial use are considerably higher than those which have been believed hitherto in Forestry Circles or Government of India.

Thus, it is clear, that 50 per cent of total Net Annual Growth from broadleaf growing stock is being used in India at present. It is obvious that there will be no shortage of tropical hardwoods for manufacturing pulp and paper during the next decade. But the heterogenous character of tropical wood for which no technology is yet ripe, will definitely come in the way. Even then it is true that about 1 million tonnes of pulp (air dry basis) were manufactured from mixed tropical hardwoods.

Man-Made Plantations

Active steps were taken to include programme of man-made forests in the plan and non-plan sectors when Second Five Year Plan was formulated. The man-made forests covered about 1.5 per cent of the total forest area in India and now after completion of the Fourth Plan it has risen to about 2 per cent. In contrast, the proportion of man-made forests in advanced countries is quite high. England has 100 per cent of such forests while Japan had 40 per cent of such forests. The table on next page shows the magnitude of investment in such plantations. Commercial Forestry has been started in the Fifth Five Year Plan where an amount of Rs. 284.5. million had been provided as Share Capital of the Equity in Forest Corporations. So far such corporations have been started in 16 States.

The table on next page highlights the total investment in the plan periods in the forestry sector, as compared to the agriculture sector as a whole. The investment in forestry was nearly 4 per cent of the agriculture sector during the First Five Year Plan period when no special consideration was there for the forestry sector. During the Second Plan period this percentage rose to a 8 per cent and then began to dwindle abruptly. It came down to 6 per cent in the Third Plan period, 4 per cent

Table-27 Investment in Man-Made Forests

Plan Period	Total invest- ment in agri- culture sector Rs. million	Total invest- ment in for- estry sector Rs. million	Total in- vestment in man- made plant- ations Rs. million	Invest- ment in man- made plant- ations as per- centage of total invest- ment.	Total Invest- ment under man-made forests (000 ha) Rs.	Invest- ment on man- made fo- rests per hec. Rs.
1	2	3	4	5	6	7
First Plan (1951-56)	2,058	85	14	16	50	280
Second Plan (1956-61)	2,764	212	68	32	217	313
Third Plan (1961-66)	7,248	459	150	32	325	462
Annual Plan (1966-69)	10,033	408	184	45	319	576
Fourth Plan (1969-74)	19,392	890	445	50	620	718
Fifth Plan	42,222	2205	790	36	1700	464

during the Annual Plans period and the Fourth Plan period. During the Fifth Plan period it is no better than 5 per cent. It is not known how the forester proposes to create new plan- tations at Rs. 387 per hectare when he spent Rs. 626 per hectare during the Forth Plan period.

Financial Outlay for the Fifth Five Year Plan

An outlay of Rs. 2,215 million has been tentatively envisag- ed for forestry development in the Fifth Five Year Plan period as against an anticipated expenditure of Rs. 891 milion in the Fourth Plan. The following is the break-up:

In the addition some substantial funds are expected to be invested in forestry sector from institutional sources.

Table-28 Outlays for Forestry Programme during Fifth Plan.

		(Rs. million)
1. States	...	1630
2. Union Territories	...	130
3. Central Sector	...	285
4. Centrally Sponsored	...	090
Total	.	2205

Man-Made Forestry—Its Benefits

It is an established fact that there is a definite need to augment the supply of raw material to meet the demand for paper. In the present era the paper is produced both from soft and hard woods. The paper industry is capital oriented requiring heavy investment. The private sector can give boost to smaller industries like plywod, saw-milling, particle board, rayon pulp etc. The forests are needed to create cheap raw materials for these industries. It is possible to do so through the programme of afforestation of extensive areas. Man-made forests are likely to benefit the nation as under:—

- (1) Suitability of the wood produced for the proposed end use.
- (2) It is likely to create large volume per unit.
- (3) Creation of such plantations will have desired accessibility in relation to market.
- (4) It is likely to create homogenous raw material, and
- (5) Processing industries are likely to benefit from man-made plantations owing to their shorter rotation coupled with quick growing characteristics.

Though there is a clear-cut-case in favour of plantation forestry as it possesses many advantages, it is confined to a smaller area as it is confronted with many problems like selection of species suited to a particular site. Procurement of quality seed is also a difficult task. Over and above there are the risks of diseases and insect attack. Constant research efforts are needed to overcome these difficulties for creating great advantage to mankind.

Use of capital for producing consumer goods gives rise to problems of interest on capital.

Rate of Interest

Basically interest exists in the world on account of the capitalistic type of production. Industrialists use capital because by first producing capital goods and then using them for manufacturing consumer goods they are able to produce them at a faster and cheaper rate, they having greater value than they could have produced directly with the same amount of labour and land. The capitalist thinks the interest as the return for the use of his capital, while the borrower of the capital views it as the cost of borrowing capital. Interest and capital are inter-related in the same fashion as wages and labour. It may be represented as a specified aggregate payment over a period of time. For example, a logger makes use of a chain saw as he can produce logs of a greater value even after paying for depreciation of the chain saw, than he could if he spend all his outlay on handsawing. Therefore the owner of the chain saw demands a rental from the user over and above the depreciation allowance. The user readily pays as he earns better with the help of a chain saw. This rental is the interest on the capital of the chain saw owner. But he can not claim the whole of this. It is to be distributed between the logger and the capitalist. It depends on the supply of and the demand for the chain saw according to which this rental is distributed. Therefore the interest rate has a high positive correlation with the productivity of capital.

The production of capital goods needs some sacrifice of consumable goods. People must forgo present satisfaction to reap a greater amount of satisfaction in future. In the present era monetary savings have an edge over the physical form of capital. Therefore the choice lies between spending Rs. 100 today or depositing them in the savings bank to yield Rs. 105 next year. Thus capital accumulates only by abstaining from current consumption. But people in general think that the present is brighter than the future and therefore would not like to wait unless they are sure of getting some direct benefit out of it.

The interest rate is usually expressed in term of per cent per annum which includes other kinds of returns lumped with it. All that is paid by the borrower of a loan negotiated with

a local bank is not reckoned as interest in economic sense. At least some portion of it is attributable to the bank's cost of administration, wages, materials, and the like. The basic rate of interest depends on the net productivity of capital and the impatience and liquidity preference of savers. This is then called pure interest—usually a theoretical concept. The actual rate of interest largely depends on variation in these other factors.

The cost of handling the loan is the first factor. Suppose a man saves with a willingness to lend it. He is required to spend time and effort in locating the borrower with a good standing to insure the safety of his investment. The negotiations will have to settle the time period involved there, the mode and time of payment of the principal and interest as well. Both sides will have to execute some papers to complete the formalities. A private investor may perhaps get it done at a cheaper rate through a broker. Though banking or other lending institutions have reduced these charges to the barest minimum, still these charges involve some costs—usually a part of the interest charged on loan.

The liquidity of the investment is a second factor affecting the rate of interest. Generally, the interest is higher if the investor anticipates difficulty in getting his investment back and the time involved is longer. An investor may deposit his amount in the savings bank at a lower rate of interest with a surety of its liquidity. If he decides on some less liquid form of investment—such as a note payable one year after the date—he may have to wait quite some time before his capital comes back to his hands in cash. He cannot withdraw it in time of emergency. In such a case he will have to sustain a loss by disposing his capital asset at loss. Thus the lender will ordinarily insist on a higher rate of interest in such a case. Forest improvements and young growing stock are not regarded quite liquid forms of capital. This characteristic, if not offset by other factors would lead to higher rate of interest on forestry loans.

Closely related to the second is the third factor of risk or loss. If the investor has no risk in lending his capital the rate of interest charged will be real interest. But often the

lender is not sure to receive the interest on every loan he negotiates or even to recover the principal in each case. Let us suppose the investor lends Rs. 100 to each the ten different borrowers at 5 per cent. If one of them does not pay him the interest, the lender collects Rs. 45 only as interest, e.g. it comes to 4.5 per cent on his capital. If he knows that onetenth of his borrowers would default, he would take proper care of the situation by charging 5.56 per cent interest on all his loans. Thus he will recover Rs. 50.04 from the nine borrowers, viz. it would work out @ 5 per cent as a whole.

Compounding and Discounting

Compounding means carrying an initial value forward in time at compound rate of interest. This process determines the end value from the initial value, at the same time determining the general relationship between the two in the light of the interest rate. Thus the initial investment required to become Rs. 110.25 in two years at 5 per cent is Rs. 110.25 divided by $(1.05)^2$, or Rs. 100. In other words the present worth of Rs. 110.25 which is encashable in two years, is Rs. 100 if the rate of interest is 5 per cent. Since capital grows on yearly basis including the interest, a compound rate of interest is charged. Take the example of a forest block which with a volume of 1,000 cubic metres were assumed to put in an increment at 5 per cent annually. From the table overleaf would emerge a system of predicting the total volume over a five-year time period. While applying the growth rate to a forest no forester would mind removing the 5 per cent increment each year. The increment is simply compounded to the previous existing volume and provided as increased base for growth over the period.

Likewise the capital has a tendency to grow. If Rs. 1,000 were invested at 5 per cent rate and the proceeds were allowed to accumulate as part of the investment, then the table overleaf would be a useful guide to predict the capital value of the principal investment as it grew each year. If the growth of the capital was removed each year, there was no question of compounding it at all. As long as the increase is compounded with the capital it serves to enhance the base for growth over the following period.

Table-29. Growth of a Forest Block with a volume of 1,000 cubic metres over five-year Period at net increase of 5 per cent per year

Year	Volume C. Metres		Calculation
Present	1,000		—
After One Year	1,050	1000	+ (1,000 × .5)
After two years	1,102 5	1,050	+ (1,000 × .5)
After three years	1,157 6	1,102 5	+ (1,000 × .5)
After four years	1,215 5	1,157 6	+ (1,000 × .5)
After five years	1,276 3	1,215 5	+ (1,010 × .5)

The result can be graphed over time to yield a typical form of growth curve. Two rates of interest (10 per cent and 6 per cent) are used in the figure, and two initial starting value (Rs. 100 and Rs. 300). There is a simple rule of thumb in respect of compounding the interest. Divide the number 72 by the selected rate of interest, the result is the number of period required for any sum to double at that particular rate of interest. For example if the rate of interest is 10 per cent it will take 72 divided by 10 or 7.2 years for such investment to double.

Discounting is exactly the reverse process of compounding. For example a rate of 5 per cent must be earned by Rs. 1,000 invested today if this amount is to grow to Rs. 1,340.2 at the end of 5 years. At 5 per cent, therefore, the present value of Rs. 1,340 2 to be received five years later in future is Rs. 1,000. It is because Rs. 1000 invested today at 5 per cent would grow to Rs. 1,340.2 at the end of five years. Since discounting is nothing more than compounding in reverse, the above graph curves appropriate to one can be used equally well for the other.

The table at page 190 shows the importance of rate of interest and the time period involve in taking decisions in respect of forestry ventures. High time preference rates are not conducive to long term investment of any kind and especially forestry. Another factor is that individuals would refrain in investing with high time preference such as plantations, thinnings and pruning etc. While the same practices may be attractive with a low time preference. Present incomes are low in developing regions of the world while time preference

GROWTH OF TWO AMOUNTS (RS 1,000 AND 2,000) AT TWO RATES
(6 PER CENT AND 10 PER CENT) OF COMPOUND INTEREST

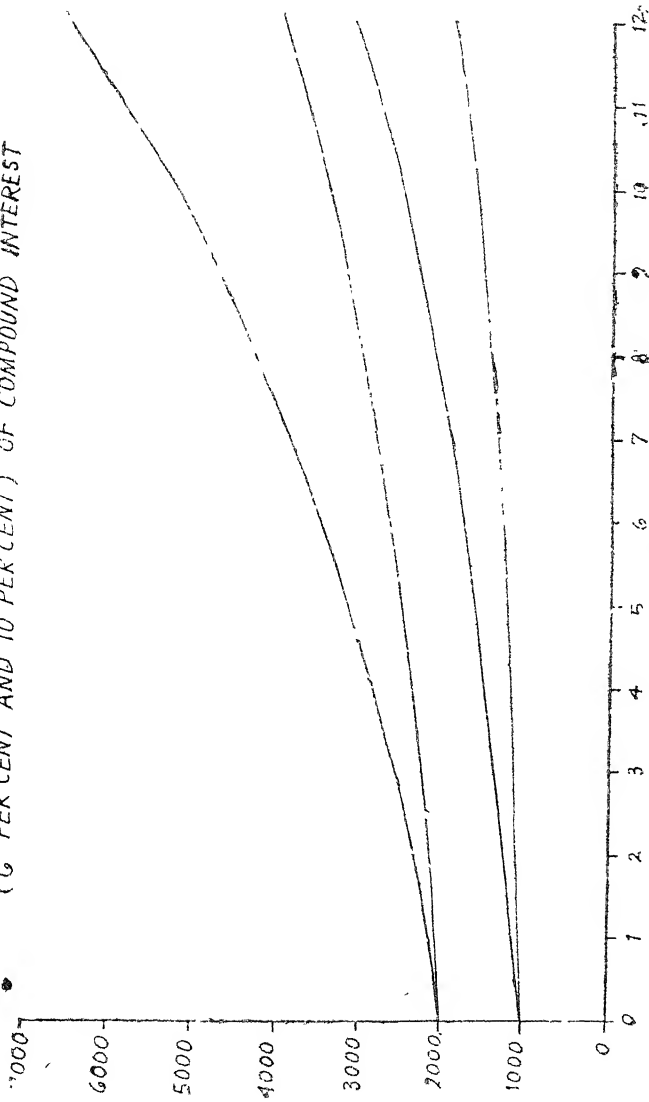


FIG 13

rate are high and thus interest are very high. Under such conditions traditional forestry finds it difficult to bear high rates of interest on the investments, made into it

Table 30—Present value of an amount of Rs. 1,000 when discounted at various rates for specified periods.

Rste/per cent	10 years	20 years	40 years	80 years
2	817.07	667.61	445.70	198.65
4	664.83	442.00	195.37	38.16
6	538.61	290.10	84.16	7.09
8	434.39	188.69	35.60	1.27
10	348.68	121.58	14.78	0.22

On the other hand the rate of interest affects the costs of forest management. Suppose a forester has a plot of land measuring one hectare to make his first investment on it in forestry. He then calculates that it will cost him Rs. 1,000 a hectare to prepare the area for planting and to raise nursery and plant the seedlings. The growth of this initial cost at various levels of compound rate of interest for four different time periods is shown as follows:—

Table 31—Growth of Rs. 1,000 over four time periods at five rates of interest.

Rate/per cent	10 years	20 years	40 years	80 years
2	1,218.99	1,485.95	2,208.04	4,876.44
4	1,480.24	2,191.12	4,800.12	23,036.00
6	1,790.85	3,207.04	10,285.72	105,880.00
8	2,158.93	4,660.96	21,728.52	471,630.00
10	2,593.74	6,727.50	45,259.26	2,047,500.00

There are a few investments which are expected to pay high rates of return for a long period like 40 to 80 years. If investment is to be done in forestry—a long maturing proposition—the funds must be available at low rate of interest. Fortunately, interest rates do tend to decrease as the length of the period of loan increases as the costs of loan management are decreased to avoid reinvestment costs.

Investment Criterion in Forestry

The question arises why forestry needs investment funds? The answer is: because forestry is an economic activity and

cannot be undertaken without the help of resources. The scarce resources have alternative uses for satisfying economic wants. Rationalisation of planning means careful consideration of economic policies. The economic criterion leading to achieve physical goals, seems to be highly satisfactory. Thus the species with highest rate of growth are likely to yield the maximum profits in the long-term. But the mere fact that technical criterion, e.g. volume of dry matter production, is not sufficient to imply that decision in respect of management must always be made on the basis of technical factors. Physical aspects do play their due role while considering the economics of alternative courses of action. It is but definite that different courses of actions will involve variations in costs and prices. The success of economic measures is more complex than those of technical performance alone. The economic measures are not complicated alone but their evaluation is impossible in the absence of full information for which a regular flow of data is needed.

The technical criterion has an edge over the economic criterion in forestry as there are two more difficulties with it. First, the final results of the contribution which the forests make to the forestry sector is not known before the trees are harvested. Secondly it is difficult to predict the values that buyers would like to affix to different products e.g., pine or teak logs due to long gestation period involved in forestry. Another difficulty arises from general lack of agreement on proper techniques for assessing the results of alternative courses of action.

Foresters and economists have always had a controversy. Foresters always tried to achieve the highest annual profits regardless of the capital employed and the time involved to build it up. All these difficulties associated with economic criterion forced the forest planner to fall back upon the obvious choice of physical measures. The history of forest management shows that the foresters have been highly satisfied with the particular silvicultural practices, the systems which they prefer. They have never tried to evolve any other criterion.

Allocation of Resources

The scarce resources are allocated to produce goods and services which satisfy innumerable human wants. Resources

must be used to maximise efficiency if largest number of wants are to be satisfied. Capital is usually scarce in developing countries like India, where people are trying to raise the standard of living of the great masses of people who need expanded supplies of forest products. Timber is needed for manufacturing paper for a large number of people for the expansion of educational programmes, packing cases for industrial products, rail roads wagons, factories and so many other purposes.

The current increase in income is not the only criterion of development but future increases also is a criterion. Capital accumulation guarantees future increases. Forestry sector is more or less a capital producing sector. Hence it is more important than the cosmetics sector which produces consumer goods alone. Accumulation of capital is a time consuming factor. It is more likely so in forestry.

Capital is likely to become obsolete if the time spent for its creation is too long. Diverting large sums of resources for creation of such capital which has a high probability of becoming obsolete before its final products are ready, can be hardly justified from the point of view of economic development. Even if the time consumed is too long, but the technological changes occurring in the economy are very rapid, then the capital will be obsolete before it is produced. The forestry sector has a long gestation period which does not give it preference over other sectors. The importance of the forestry sector diminishes with every advance in technology under other sectors. It is worth noting that forestry produces "versatile" capital which gives it an advantage over other kinds of capitals.

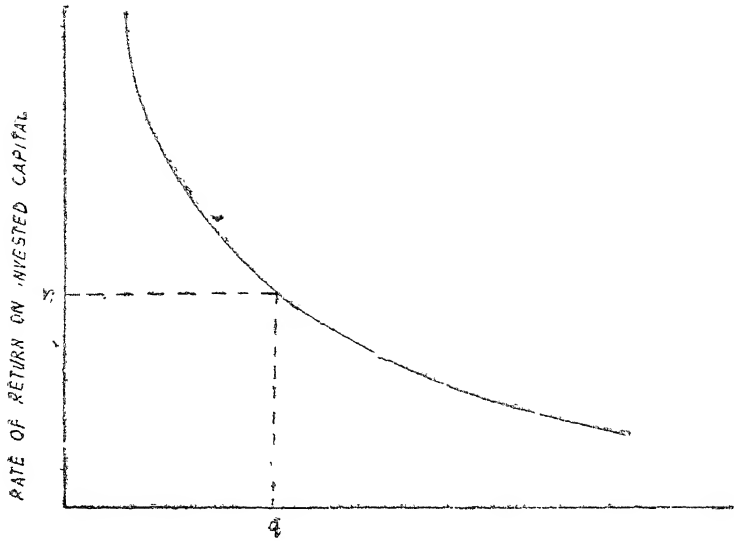
The forestry sector as a producer of versatile capital—wood, has a considerable advantage over many other sectors. The forestry sector can claim investment on priority basis if it can produce raw material which is cheaper than its substitutes.

Having decided that there is a certain total investment for the economy as a whole in any one year, it is to be seen how much of it should be allocated to each sector and how much should be allocated to forestry sector. Foresters in under-

developed countries have been arguing in favour of higher outlays for the forestry sector. Such arguments fail to impress the economist without the use of proper economic tools for analysis. The government is committed to the goal of economic development if forests are almost controlled by government as is the case in India. The maximisation of revenue to the exchequer for pushing the economy towards take-off stage is the function of forestry in such circumstances. This is possible when the present worth of the forests is maximised by the foresters and the government is ready to invest in those sectors which are a great hindrance to an increase in productivity. Simultaneous decisions must be taken regarding the optimum amount of forests to be exploited in any one year and the optimum amount of "investment funds" to be put into new afforestations or regeneration.

Interest and Resource Allocation

The investment of capital in a market economy depends on the interest. The markets for securities in industrialised countries are highly organised and closely integrated. Security prices and rate of interest are affected by the risk involved, time preference, and the supply of money in the market. People controlling some funds for investment judge the opportunities in forestry and in timber production against all other investment opportunities available to them. They weigh the rate of return from timber growing and other forestry production opportunities against their alternative rate of return viz. the opportunity cost of capital. Every investor prepares his own schedule to investment alternative by comparing the rates of return from each alternative and adjust them in descending order. The result will form a curve by plotting the rate of return over the accumulating capital required for investing in a successive opportunity. An individual having capital for investment will justify when the capital OY is invested in the opportunities which will give him the return OX as in the figure overleaf :—



TOTAL CAPITAL INVESTED IN SUCCESSIVE PROJECTS
 RATE OF RETURN TENDS TO DECLINE WITH EVERY
 SUCCESSIVE INCREASE IN THE AMOUNT OF INVESTMENT
 FUNDS.

FIG 14

CHAPTER 10

Economics of Forest Land

Economics Of Forest Land

Land is clearly an essential factor of production in general but it acquires a special place in forestry. It occupied a very important position as a factor of production in early economic writings —a free gift of nature limited in quantity. Land means natural resources as opposed to human and cultural resources. It includes, generally speaking, the surface and substance of the earth. But in forestry land means the place, or space or whatever one may call the site of production. Like labour and capital, land possesses a quality aspect also. The quality of land is closely related to latitude, longitude, topography, composition of soil, climatic conditions, geographic situation relative to other units of resources and to economic activities. Though the production function of land, primarily in timber growing stage, is very important in forestry, considerable amount of land is required in the next stage too. Land is a limiting factor in timber growing in those countries which have a large population and comparatively small land area. This situation is likely to aggravate further with the pressure of constant increase in the population of the world. Thus it throws a challenge to land for supply of more products and services. This situation gives rise to the study of the characteristics of land as a productive factor of production in forestry.

Characteristics Of Land

In the first place land is limited in quantity and it is non-reproducible. Man definitely knows that there is a particular quantity of land available in the country. He cannot produce more land like capital which he can increase or decrease by his actions. Though there are some instances where he has been able to increase land by driving away water, e.g. in Holland where land has been reclaimed with the help of dyke system and submerged land has been made available for the use of the people. But the non-reproducibility of land is import-

dant because in any long way of thinking land must be treated as a fixed factor of production. The total quantity of land is fixed while the economic problem is to utilise this land in the best combination with other productive factors.

The immobility of land is a very significant characteristic of land. As one is able to move capital equipment and labour from one place to another, the land cannot be moved likewise due to its immobility. It must be utilised at the same place where it exists. Labour and capital must be brought to the land if it is to be used with the production function. The land is usually fixed for all practical purposes in a region. It does not matter much how intense the demand is for the services of land in a region, more land cannot be transferred to that region from adjoining or far off regions where land might be lying unused in abundance. But the provision of transport facilities will provide better means for utilising the services of land. An efficient means of transport can cut down the price of movement of goods. Thus it is possible that lands which are situated 50 kilometres away and 10 kilometres away from the plywood factory may compete in production but still the difference of distance will certainly count.

The third characteristic of land is its indestructability. The usefulness of land may be reduced temporarily for certain purposes but it may be regained with proper treatment after some time. Land may be used—under proper circumstances—without destroying its quality or even leaving its important characteristics unchanged. If land becomes worthless for one purpose it can be diverted to another. Thus the limited amount of land can continue to shower benefits without being used up in the process. The land resources are very important for the humanity. But despite extensive soil-conservation measures and programmes land resources could not still be saved from depletion and destruction in this process.

In fact land is never destroyed or depleted in the process of production but rather the services provided by that land are consumed or utilised. For example one hectare of land used for the production of raw material of forestry origin is potentially capable of growing a certain amount of wood during the course of a year. This quantity of wood can continually be

produced by this land on sustained yield basis. This is then the potential flow of woody growth over time. Another example is provided by a park in the jungle. If 50,000 people visit National Corbett Park in U.P. to derive pleasure in one year, more than the number or at least the same number of people can derive pleasure the next year at that park. In this respect it is a 'flow' resource. The recreation productivity of this park is a potential flow for the visitors. Thus the varied services of the forest seem to have a continuous flow while keeping the resource intact.

But the following conditions are very important to receive the flow of services regularly. (1) The flow remains potentially permanent in the case the land remains intact in the process of obtaining the flow. Land should not be misused or damaged while in use to the extent that it impairs the flow of services temporarily or permanently. (2) Land must be potentially capable of producing these flows of services. Man must use these flows in order to get benefit from them. These services have a tendency to fade permanently if they are not used regularly. These flow services cannot be stored for use on some subsequent date. If one hectare of land, capable of growing 5 cubic metres of wood in a year, is left idle and unvegetated for a year, the lost wood growth cannot be compensated for next year by growing 10 cubic metres in any succeeding year. Therefore land as a flow resource, must be used constantly to obtain its full potential benefits. It is very important both making full use of economic resources and preventing their misuse and consequent destruction.

Another important characteristic of land is variation in quality as a productive factor. First of all land varies in its natural productivity. For example plot No. 'A' of land may be capable of growing larger amounts of wood per year than plot No. 'B' due to its origin, structure and natural make up and soil fertility. Such difference in productivity may or may not relate to the location of the land which depends on climatic conditions, elevation and other aspects. Land having the same natural productivity is likely to be more efficient as a productive factor if it is accessible to use closely connected with markets. Land is graded to have different productive capabilities. The

quality of land may differ greatly within a specified area. Differences in quality of land cannot be accounted for practical management. However major difference in land quality must be recognised.

Finally a given plot of land may be put to different uses, e.g. for growing agricultural crops, pastures, or forests. Some forest lands may be suitable for growing decorative timber or pulp wood. All forest lands are quite suitable for residential purposes where it is needed for this purpose. Only the forest lands inaccessible in character can be suited for forestry purposes. Even these lands may be useful for more than one purpose in forestry. Any special forestry use must compete with other uses for much of the forest land. These uses in forestry make alternative cost more important in taking up any economic analysis of land use.

The Forest Lands of India

The forest land area of India is estimated by the forest service to be about 74,573 thousand hectares during 1972-73. It constitutes about 22.7 per cent of the total geographical land area of the country. The following table gives the forest area by States and Union Territories and the percentage of forest area to the geographical area in each case. Figures of exploitable area and potentially exploitable area are given below:—

Table 32¹. State-wise Classification of Forest Area in Terms of Exploitability during 1972-73. ('000 ha)

States/U.Ts.	Geogra- phical area	Forest Area	Production Forests			
			Forests in use	Poten- tially exploitable	Total	Other forests
1.	2.	3.	4.	5.	6.	7
1. Andhra Pradesh	27,681	6,480	3,111	1,660	4,771	1,709
2. Assam	7,852	2,855	2,687	165	2,852	3
3. Bihar	17,388	2,932	2,658	—	2,658	274
4. Gujrat	19,599	1,708	1,523	—	1,523	185

¹Bulletin No. 11, issued by the forestry commission (forestry statistical Cell) Govt. of India.

5. Haryana	4,422	152	63	30	93	59
6. Himachal Pradesh	5,567	2,169	1,203	447	1,650	519
7. Jammu & Kashmir	22,224	2,104	1,262	202	1,464	640
8. Karnataka	19,177	3,386	2,615	771	33,386	—
9. Kerala	3,887	1,128	108	243	351	777
10. Madhya Pradesh	44,284	16,835	10,182	4,009	14,191	2,644
11. Maharashtra	30,776	6,603	4,315	1,908	6,223	380
12. Manipur	2,236	602	291	311	602	—
13. Meghalaya	2,249	699	72	627	699	—
14. Nagaland	1,653	288	52	207	259	29
15. Orissa	15,578	6,793	5,683	1,042	6,725	68
16. Punjab	5,036	216	100	—	100	116
17. Rajasthan	34,221	3,623	1,544	1,036	2,580	1,043
18. Sikkim	730	—	—	—	—	—
19. Tamil Nadu	13,007	2,234	1,419	408	1,827	407
20. Tripura	1,048	628	240	190	430	198
21. Uttar Pradesh	29,441	5,013	3,462	782	4,244	769
22. West Bengal	8,785	1,183	1,080	65	1,145	38
Total States	316,841	67,631	43,670	14,103	57,773	9,858
II. Union Territories						
1. A & N. Islands	829	746	503	243	746	—
2. Arunachal Pradesh	8,358	5,154	700	1,500	2,200	2,954
3. Chandigarh	11	—	—	—	—	—
4. Dadra & Haveli	49	20	20	—	20	—
5. Delhi	149	4	3	—	3	1
6. Goa, Daman, & Diu	381	131	38	68	106	25
7. Lakshadweep	3	—	—	—	—	—
8. Mizoram	2,109	887	—	521	521	366
9. Pondicherry	48	—	—	—	—	—
Total U.T.	11,937	6,942	1,264	2,332	3,596	3,346
Grand Total	328,778	74,573	44,934	16,435	61,369	14,204

The above table indicates that forests area comprises 22.7 per cent of the total geographical area of India. Of the total forests area 74,573 thousand hectares about 60.3 per cent are considered to be exploitable under present conditions. The exploitable forest resources comprise 61,369 thousand hectares or 82.3 per cent. Of this 44,934 thousand hectares or 60.3 per cent are actually in use and the rest 16,435 thousand hectares or 22 per cent potentially exportable forest areas.

Topography

The topography of a country plays an important role in setting the pattern of land use in general. Coupled with climate, topography is particularly very important to influence most regions of the world in respect of population, development of communications. Thus it needs great care for fixing the land use in the Alps, Himalaya, and the other great mountain ranges, landslips, scree, avalanches and torrents. All the above facts have a great significance in setting the limits to settlement and agriculture.

Forests have a great association with mountains and hilly tracts throughout the world, because such regions are neither suitable for human settlement nor for agriculture. On the other hand such areas in arid climatic zones are solely to provide enough moisture for tree growing. A typically dominant land use is for agriculture in flat countries like India, having dense population. The second best and extensive use of land is for forestry.

However, the present proportion of forests in many regions may be low as a result of forest clearance. Therefore, artificial plantations are likely to play an important role in stabilizing soils, in preventing soil erosion by winds, and in sheltering crops, animals and habitation.

The working of forests is often influenced by topographical situations, for example, the long and deep rivers in Russia, Sweden, Central Europe and South America are a means to provide a cheap and convenient system of log transportation over great distances. Topography also helps construction of roads wherever they are necessary for extraction purposes. The

cost of road construction particularly rises high in mountain regions.

The Profitable Use of Land

The Economics of forestry has to take into consideration the alternative uses of land as well as other factors of production. Land is claimed for so many uses agriculture, urban development etc. Some are complementary uses such as forestry. Agriculture and recreation are other uses. Location of some lands make them so highly valuable for urban and industrial development, for urban recreation and for construction of roads, that neither forestry nor agriculture can compete for them. Forestry in India is unlikely ever to be a hard competitor for large areas of fertile land. Rather the agriculture may take away some chunks of good forest lands for crop production.

Despite the National Forest policy envisaged in 1952 prescribing that India as a whole should aim at having at least one-third of its geographical area under forests, about 4.15 million hectares¹ of forest lands were deforested since Independence upto 1976 but the following table accounts for about 3.4 million hectares during 1951-52 to 1972-73.

Table. 33.² State-Wise Forest Area Lost for Various Purposes.
(‘000 hectares)

State/UTs.	Total Forest Area	Forest Area Lost on Account of	Miscellaneous Purposes			
		River Valley Projects	Agricultural Purposes	Construction of Roads etc.	Establishment of Industries	
1.	2.	3.	4.	5.	6.	7.
States						
1. Andhra Pradesh	163.6		27.9	120.8	—	8.2
2. Assam	66.6		19.7	14.2	6.6	0.9
3. Bihar	62.6		1.3	48.3	1.1	11.1
4. Gujarat	173.0		34.7	20.5	0.3	1.0
5. Haryana	0.1		—	—	—	0.1
6. Himachal Pradesh	21.1		7.6	6.7	1.1	—

¹Indian forestry 1978, Forestry Division (Department of Agriculture) Ministry of Agriculture & Irrigation Government of India.

²Bulletin No. 11, issued by the forestry Commission (Forestry statistical cell) Government of India.

1.	2.	3.	4.	5.	6.	7.
7. Jammu & Kashmir	0.8	0.1	0.3	0.2	—	0.2
8. Karnataka	149.0	28.7	79.5	1.7	1.5	37.6
9. Kerala	115.0	7.8	94.6	0.2	12.1	0.3
10. Madhya Pradesh	1,586.4	69.2	1,453.3	.4	24.8	38.7
11. Maharashtra	184.3	10.3	97.1	32.8	7.9	36.2
12. Manipur	—	—	—	—	—	—
13. Meghalaya	—	—	—	—	—	—
14. Nagaland	2.1	—	—	—	2.0	0.1
15. Orissa	91.4	32.5	8.3	0.8	24.0	25.8
16. Punjab	0.5	—	0.4	—	Neg.	0.1
17. Rajasthan	70.6	14.5	31.3	0.3	1.3	23.2
18. Sikkim	—	—	—	—	—	—
19. Tamil Nadu	6.01	45.1	2.2	0.1	0.3	12.4
20. Tripura	18.6	7.4	10.6	0.2	Neg.	0.4
21. Uttar Pradesh	215.5	93.2	79.7	3.4	19.3	19.9
22. West Bengal	321.8	1.3	313.4	1.9	2.9	2.3
Total States	3,303.1	401.3	2,381.2	51.1	117.4	352.1
Union Territories						
1. A & N Islands	10.6	—	7.0	0.5	Neg.	3.1
2. Arunachal Pradesh	40.0	0.1	26.3	0.4	7.1	6.1
3. Dadra & Nagar Haveli	0.5	—	0.5	—	—	—
4. Delhi	0.1	—	—	0.1	—	Neg.
5. Goa Daman & Diu	21.1	—	17.4	2.7	—	1.0
6. Mizoram	—	—	—	—	—	—
7. Others	25.6	—	—	—	—	25.6
Total U. Ts.	97.9	0.1	51.3	3.6	7.1	35.8
Total India	3,401.0	401.4	2,432.5	54.7	124.5	387.9
Percentages total Forest area lost.	100.0	11.8	71.5	1.6	3.7	11.4

A pragmatic policy is needed to preserve and consolidate the existing forests and to afforest new areas covered by wastelands. This declining trend in forested area is visible throughout the world when it is found that an appreciable change is expected in this ratio within the next 30 years viz. a net loss of 4.5 per cent in the forested area and the conversion of an estimated half of the present forests into grassland or crop lands. It matters little about the quantum, man has little land to exploit and to expand himself.

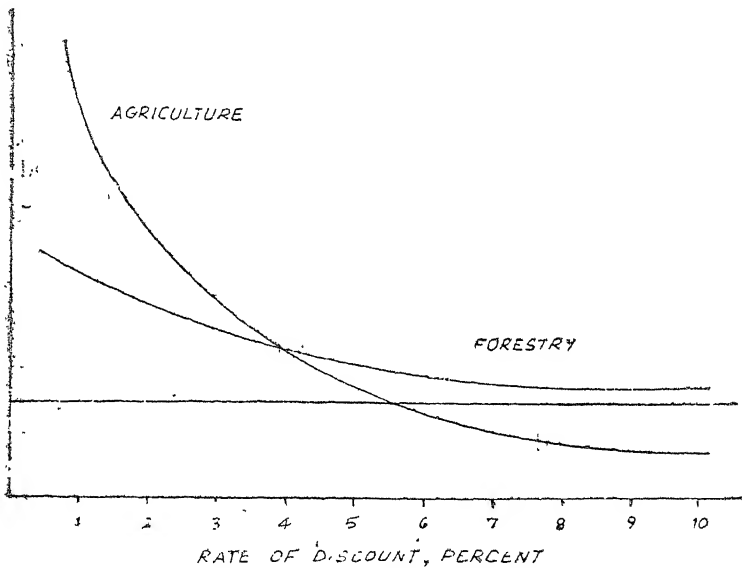
A look at the table overleaf shows that Madhya Pradesh tops the list in respect of forest area lost in India for different purposes. It is followed by West Bengal. Then come Karnataka, Uttar Pradesh, Maharashtra and Kerala respectively.

Generally the present view is that any land available for use for productive purposes should be used regardless of its cost of production. But it is clear that both food and wood should not be produced at a loss, unless it is counter-balanced by other benefits of over-riding priority such as creation of employment opportunities or the regulation of water supply or the production of raw materials for feeding the industries. This is likely to be done when the processing of it might have sufficient margin of profit to counter-balance the loss incurred in growing it. Uncultivated land may have a considerable value as a water catchment area or it may prove to be a good recreational ground, or scenic beauty. There are some 24,436 thousand hectares in India which are not accounted for under any nomenclature. Out of this area forestry claims 10,245 thousand hectares. This area is under forests only in name. Virtually there are no trees standing on this land except some scrub and shrubs. Generally the forester clamours that the forests are being encroached upon by unauthorised clamants. It is absolutely true that other people are tempted to use a certain property which is not claimed and used by its owner. So forests fall in the same category.

The major economic problems in land use, so far as forestry is concerned, are to determine where the economic limit for forestry should be drawn so as to save the forestry land from being transferred to agricultural use. But the problems other than economic considerations do complicate the

issue. Since forestry is a long term venture to lock up capital as compared with agriculture which has a relatively rapid turn-over, the rate of discount which is used in economic calculations generally determines the relative profitability of the two forms of land use.

Generally speaking, agriculture is more profitable at low, while forestry at high rate of discount. The following figure illustrates this point clearly. It becomes clear that at a high rate of discount the net discounted revenue for forestry is positive and that for agriculture negative, whereas at low rate of discount it is higher for agriculture than that for forestry.



VARIAION OF NET DISCOUNTED REVENUE WITH
DISCOUNT RATE IN FORESTRY AND AGRICULTURE

FIG. 15

Pattern of Land Utilisation

Agriculturists in most of the regions near forests largely depend on the adjoining forests for their requirements of wood and grass which further interfares with the growth of forests

and thus complicates the problems. The most extensive agricultural areas comprising the Indo-Gangetic plains in the north and the coastal plains in the south have a tendency to become almost treeless. In this context it may be useful to look into the pattern of land use in India as follows:—

Table 34.¹ Geographical Area and Classification of Reporting Area in India—1975-76.

Description	States	Union Territories	('000 Hectares)	
			Total	Percentage
1.	2.	3.	4.	5.
I. Geographical Area	316,841	11,937	328,778	100.00
II. Reporting Area	295,171	9,171	304,342	92.57
(a) Forest Area	59,110	7,312	66,422	20.20
(b) Area not available for cultivation.	39,163	355	39,518	12.02
(c) Other uncultivated land excluding fallow land	33,778	393	34,171	10.39
(d) Fallow land	21,354	632	21,986	6.69
(e) Net area sown	141,766	479	142,245	43.27
III. Area not accounted for under above	21,670	2,766	24,436	7.43

There are many competitive uses for the land that now is or might be devoted to forestry. In the total historical picture the most important of these has been agriculture. Next to agriculture, forestry is a major land use. This does not invariably mean that all the area which is termed as 'forest' is

¹(Part-I) Classification of Area and Irrigated area 1975-76—Statewise (Provisional)—Directorate of Economics & Statistics Ministry of Agriculture & Irrigation (Krishi Aur Sichi Mantralaya) Department of Agriculture (Krishi Vibhag) Government of India (Bharat Sarkar)

covered with tree growth. The figure includes hot and cold deserts, vast stretches of saline and alkaline lands, barren and eroded hill tops devoid of vegetation. It is estimated that about half of the area legally classed as forest land has really productive forest area. Therefore, it can be said that India has a much lower percentage of forests than what it should have, taking into consideration the climatic conditions characterised by droughts and floods in some parts of the country or the other. Therefore, it is of great importance to maintain this small area under forests for maintaining a proper environment for meeting the social, industrial aesthetic and recreational needs, as well as for providing a suitable habitat for our rich and varied wild life.

Land Expectation Value

The land expectation value worked out as per Faustmann's Formula comes to Rs. 445 per acre (see Appendix I). This value compares very favourably with the prevalent value of agricultural lands, considering the terrain and fertility of forest sites.

The most striking feature of development in recent years has been the increase in the amount of land devoted to urban and industrial uses. Though the concentration of population is in the rural areas, due to industrialisation of the country there is a definite shift of population towards the cities. This trend has been caused by the improvement in transport facilities and specially the widespread use of the automobile.

There has also been a big increase in the use of land for highways which are on the increase day by day. Power lines, pipe lines and other rights-of-way have begun to cover a large area of land particularly in the cities. It has also begun spreading in the villages and the interior places of the country. Thus it is estimated that each kilometre of road in urban areas uses about 10 to 15 acres of land but even then this percentage is negligible in the rural areas at present.

Water management—which is of great importance in India is affecting forest land in two different ways. (1) Reservoirs and other impoundments usually cover sizeable areas of forest land. Often this land is highly productive. The loss

of timber production from such lands is far greater than the area would indicate. On the other hand management of watershed lands for erosion control often needs the afforestation of some parts of these watersheds. This is likely to add to the area of commercial forest land if such lands belonging to watershed can be used for both production of timber and water. But such lands are exclusively earmarked for water production. This forest area is not used for timber growing at all.

Finally, the demand for forest land is growing in the world for use as recreational ground. Recreational use for forest land is also growing in India but not to that extent as in economically advanced countries. The forests should be accessible to recreational use. The forest land best suited to such use usually has a great potential for the production of timber. Recreational use of forests is bound to increase in India as it is increasing in the world. Extension of areas for recreational purposes is almost certain to be at the expense of the area of commercial forest land.

A notable fact is that forest land of the world include a major area of unexploited forests. India has a small area of this type confined to high mountain ranges. Surely there are some forest lands from where no timber has so far been removed. But if these lands were accessible, they could form a part of some large exploitation operation which is sure to extend to them also in due course. Canada and Mexico have got a good deal of unexploited accessible forest land which might become a source of wood supply to the world market. Again these countries may consume much of this potential themselves instead of exporting to other countries. Latin America has tremendous unexploited forest resources. These resources have large quantities of unknown timber species—hardwoods. This potential source of future wood from Latin America might prove useful for some specific use. There is one possibility that technological development might lead to the economic harvesting and utilization of timber from the forest lands which are at present considered inaccessible. If the demand for wood strips its supply, some of the land now reserved for parks, wildlife refuges, and similar purposes might

be opened to commercial exploitation. No doubt such action is likely to increase the commercial forest areas but by only a small proportion. At the same time it may be necessary to do away with even less area because part of this area will be utilised inevitably for other more urgent uses. Therefore the present commercial area in use viz. 54,197 thousand hectares might remain intact in the long run.

Forest Land as a Productive Factor

There are mainly two important characteristics of the forest land in use as a productive factor, viz. (1) physical limitations, i.e. more land cannot be produced and (2) quality variations, i. e. all the existing land differs in quality.

The supply of such land as is suited for one purpose becomes perfectly inelastic. It means that the availability of such land is limited even if a very high or low price is offered for its services. The price which an owner can command for the use of the services of land depends on the supply of such land in relation to demand for its use. Such price is known as rent in economic term. If a plot of land is particularly suited to produce the services in demand, it is likely to command high rent. The rent of a marked plot of land will be high if it is capable of producing a variety of services. The land suitable for growing timber for pulp or plywood or grain, hay or pasture presents an example. If the timber grower is not willing to pay the price asked for, the land owner will certainly bargain and rent it to a cattle rearer or a farmer. This is called composite demand for all the different producers who are interested in using the land.

An important factor to determine the returns to land as a productive factor is its scarcity. Generally the forest lands are in abundance where most of the forest products can be raised on a wide range of land quality. If forest land did not differ in quality and were available in limitless quantity, it would be treated as a variable factor in production. In this case labour and capital would be used with each acre of land in the best combination to produce plywood logs at the lowest average cost per cubic metre. If the average cost did not exceed the price which could be obtained for the wood thus produced, additional acres would be put to growing plywood logs. Since

the demand for ply logs is not perfectly elastic, a fall in price will be necessary to sell the additional output. The marginal cost of growing ply logs will increase because the supply of labour and capital were inelastic. In such a situation a point is likely to reach the final stages where it would not be profitable to bring any more and into use. It is because the marginal cost of ply logs which could be grown on an additional acre would be greater than the marginal revenue likely to be obtained from growing that wood. Since this point would occur in such a position where all the land cannot be in use, the owners of it will be in a position to obtain only a very small price for its use.

All the forest land, which is available in limited quantity, differs in quality. The forester who plans to grow ply logs would find that he could obtain the lowest average cost per cubic metre on the best-quality land. Thus he will start planting on such land. But even after using all the best-quality land the forester finds that his produce of ply logs were not enough to meet the demand. At this point he is getting some margin of profit, therefore he would like to bring the next best-quality land under tree growth for ply logs. It is profitable to him to expand his production as long as the marginal cost remained less than the marginal revenue. He may have to follow either of the two courses, viz. intensive use of his best-quality or extensive use of his second best-quality lands and so on.

Land, Economic Rent And Value

The forester obtains a net revenue by growing timber on forest land. Growing timber on land requires the services of labour, capital and an entrepreneur and the services of land as well. Suppose that in some timber growing venture the other factors besides land are being paid at their alternative rate. Thus there is no room for these factors to be employed elsewhere. If after meeting all his production costs at these alternative rates, the forester saves up a net revenue from his operation, this net revenue must be due to the services of land which he has used. This return to land as a productive factor is called economic rent.

The rent from the point of view of the land user, is the cost of the land—an explicit cost if he gets the land on lease from someone else, an implicit cost if he owns it himself.

Economic rent may or may not be synonymous with ordinary rent. Rent in the ordinary sense of the word is used to connote the amount paid by a user to the owner of a property for the right to use its services for a fixed period of time. Economic rent is usually the maximum amount that a user could pay for the use of a certain plot of land for some productive purpose during some period of time. It is that amount which leaves some profit after paying for all the other productive factors at their alternative rate. Thus economic rent forms a theoretical basis for determining land rents and the value of land as property.

The land produces economic rent because there is no uniformity in the quality. Its availability is restricted at any place. In this case more and more acres of land would be utilised until the quantity produced overwhelms the quantity demanded and thus force the price to fall to a point where it would just cover the cost of the other factors, including normal profit. Had the land been actually in possession of some owners they might try to hold out for an optimal rent for the use of the services of their land. But sometimes in new colonies the rental goes to zero. The user of the land may get it by bargaining one owner against another and thus drive the rental demanded for the land down to the zero level. Such an extreme situation is hardly conceivable in real life. In the early history of the forests of our country the forest land was virtually valueless. The lumberman bought it for removing the standing timber and then sold the land for agricultural purposes. If such land proved to be submarginal for agriculture, it was reverted to the government for non-payment of taxes.

If land is suitable to be employed for more than one use, it is valued from that use which is the most profitable. A plot of forest land out of which a most competent forester cannot get more than Rs. 50 per acre per year, might prove useful for Rs. 10,000 per acre if it is located in a newly developed housing scheme. However, these alternative values also have

a bearing to be determined basically by the potential economic rent to be earned in these alternative uses.

If all the available land is useful for growing forests, economic rent will arise due to its quality as all the land cannot be of the same quality. As long as quality I land is available, it is counted as marginal land, without producing any economic rent. When all the land of quality I is exhausted and the demand for forest produce still persists, quality II land will find an opportunity to be employed for production of forest raw material. Since quality II land will produce less than the quality I land, quality I land will command economic rent. Furthermore if the demand still remains unsatisfied, quality III land will come to be employed for production of raw materials of forest origin. Under this situation quality I and II lands will begin to yield economic rent. When land of different qualities is involved economic rent shows up as a differential rent.

If all the lands were of the same quality, economic rent will still arise due to situation. The land which is situated near the market will command economic rent since the cost of transport and other overhead charges will be less than in the case of those lands which are situated far away from the market.

The value of a plot of land as a productive factor depends basically on the economic rent that can be earned by using it in production. The economic rent to be used for estimating land value is that which would be earned if the land is put to its best economic use managed intensively, that is, the maximum possible economic rent. Since economic rent is usually an annual income, the value of land can best be found out by capitalizing this annual income. Capitalizing is simply a reverse process of determining the amount of return which a capital sum will produce at a given rate of interest. The capital sum of Rs. 10,000 will bring in a revenue of Rs. 500, therefore, is Rs. 10,000 if it is capitalised at 5 per cent. The value of a plot of land can be calculated by the following relationship :—

$$V = \frac{r}{i} \quad \text{i.e.} \quad \frac{500}{5} = 10,000$$

Where V is the value of a unit of the land, r is return or cost recurring annually or periodically (interval longer than a year), and i is the rate of interest expressed as a decimal. This means that the promise of a constant annual payment, r , and the sum V , have equal value, or that the value V can be found out by dividing the income by the rate of interest expressed in decimals. When it bears a rate of interest of 5 per cent, it is immaterial to one if he owns Rs. 10,000 or a plot of land promising a net return of Rs. 500 yearly. If it was a matter of indifference you should be willing to exchange the one for the other even-up—that is, the land is worth Rs. 10,000. It runs on the assumption that the risk in the forest investment and the risk in some alternative investment of Rs. 10,000 which will yield Rs. 500 or 5 per cent interest are judged essentially equal.

The process of capitalization can be used equally well in respect of cost as it is in case of revenue—or indeed of any recurring value. Suppose you have a small bundle of woods on which an ad valorem property tax is levied as Rs. 5 per year. This tax may be capitalized at some appropriate rate of interest. Again if the tax is taken to be 5 per cent, the capitalized tax is Rs. 100, the present worth of all the anticipated tax payments discounted at 5 per cent interest.

The value of a plot of land which is calculated by capitalizing economic rent, depends largely on the rate of interest which is used. The alternative rate is the proper rate to be used. This is that rate which a prospective buyer of land can possibly earn by investing his capital in the best alternative venture involving equal risk according to his thinking. The higher the rate of interest used, the lower will be the value obtained and vice-versa.

Economic rent is mainly dependent on the price which can be obtained by selling the products and on the costs of the other factors involved in production. Since the value of land has a direct bearing on economic rent, the value will have a tendency to rise with rising prices and to fall with falling prices. This shows that the value of the land is unstable. The value of land fluctuates with general economic conditions and may follow any definite trends in price and cost.

Cost of Production and Services of Land

Though according to the concept of marginal land and economic rent the return to land is said to be a residual item after compensating every other factor of production for its services, in a cost-revenue analysis of any actual production situation the cost of land as a factor of production must be treated just like the cost of any other factor of production. Land often differs from other factors of production in its cost aspects.

The forester might obtain the services of the land for growing trees in one of the two ways: (1) he might buy the land for his use and (2) he might secure the land on rent from some other owner. If he purchases the land as it is the case in India, it becomes a part of his capital investment. It is then analogous to buildings, roads, factories, machines, and other capital goods which he purchases for use in his production. The revenue analysis is incomplete if he does not charge himself implicit interest on the value of the land he owns for utilising its services. The price for which he might sell the land instead of using himself is the value of the land which he should use in determining this interest cost, viz. the alternative cost. In this case the alternative cost forgone is that of selling the land and investing the money in some other venture. In an accounting sense the land is mixed with the rest of the capital of the forester so that it is difficult to compensate the share of land separately. The share of land is included in the net operating revenues of forester.

The rent of the land is a cash outlay which becomes a part of the direct operating cost if the land is rented from some other owner. In India forest land is a public property. Therefore the problem of renting the land for growing timber does not arise. It has been much less common in the United States to rent land for timber growing than for other productive purposes. Farms are rented for agricultural purposes in India but unlike U.S.A. these farms do not include any amount of forest land. Forest lands are a different proposition in India.

CHAPTER 11

Transportation

“Efficient transportation does much to promote the growth and distribution of wealth, to develop broader markets, to foster the division and specialisation of labour, to bring labour and capital into fuller realisation of those opportunities making for their more profitable employment, to bring about a greater and more profitable interchange of products and services and thus to promote the growth of human welfare” Holtzclaw.

The development of transport as an all pervading industry is one of the main characteristics of economic growth in this country. The climatic conditions and natural resources play a decisive role for production of certain goods and services, while cheap transportation makes them available at a competitive price elsewhere even. The economy can sustain at the best, those goods which have a cushion to bear high transport cost but cheap transportation permits other goods to flow in the economy. The transport services have developed and intensified with consequent repercussions on all economic activities, i.e. trade and industry etc. During the last 25 years, the investment in the transport sector accounted for about 20 to 25 per cent of the total developmental expenditure. The transport development programmes include two major groups. The first group contains transport services and their development programme to meet the internal needs of the country. The second group encompasses international links, overseas trade covering long haulage by sea and air. However, this chapter considers the first group alone.

Transportation Enhances Economic Development

During the 19th century rail and road building activities covered the entire world as it was a belated realisation of the public that transportation plays a major role in the economic development of a country.

Colonial powers covered many underdeveloped regions of the world with railroads with the intention to develop and husband regional natural resources. Building of railroads was specially done with the purpose to connect hinterland with the seaports in India, Burma, Argentina, and Australia. This action had twin objectives in sight—(i) to export agricultural and other products alongwith raw materials to support industries abroad and (ii) to import finished goods from industrially developed countries of the world. This action was taken to capture the new markets in the colonies.

Both—public and private—investment came forward to create the means of transport for performing development function. Even the private capital invested in the railways was often motivated by expectations of indirect economic gains—appreciation of land values, greater profitability of agriculture and other enterprises—rather than purely by profits accruing directly from railway operations. Thus it is seen that much of the British capital invested in railroads in Argentina was motivated by the indirect gains expected to flow to the British owners of enterprises engaged in various commercial activities in the country¹ by opening up virgin resources of raw materials from the hinterland. Investment decision in railroads has been taken for enhancing gains from the primary and the secondary sectors of the economy.

Geographical Division of Labour

Geographically, labour can be divided into two groups. In the first stage the advantages arise when certain commodities A and B can be produced cheaply in regions X and Y. Thus all the parties benefit when they avail of the advantages of fair exchange between the two regions. Exchange of commodities will become impossible if transportation costs offset the gains, other things being equal. This situation will compel the community in region X and Y to devote some of their land, labour and capital to produce that commodity too in which each region specialises. Neither any trade can take place nor any specialisation can be achieved if there is the barrier of high transporta-

¹Ferns, H.S., *Britain and Argentina in the Nineteenth Century* Oxford University Press (1960), pp. 337-338.

tion costs. As specialisation of production takes place the community living in region X makes purchases of commodity A and vice-versa. Such action is justified to conserve energies to produce the commodities at a greatest advantage. This is known as the principle of 'Comparative Advantage' or 'Comparative Costs'. This is very useful in studying international trade. This principle has a wide application, viz. to trade between regions/areas of the same country, to division of labour between individuals as well as between localities. Thus we find why most of India's cotton grows in the black soil in Deccan and jute mostly in Bengal.

The division of labour is highly profitable to the society if every community specialises in the activity for which it is best fitted. This action will take the output at the optimal stage, which makes free trade possible. Specialisation of production and consequential gains depend on cheap transportation. Adam Smith's remark that the division of labour is limited by the extent of the market¹, is true in respect of any form of division of labour, it is specially appreciable to geographical division of labour. In the absence of cheap transportation, territorial division of labour can have little justification.

The producing and consuming centres can have linkage between them in several ways. The commodity flow between inter-district/inter-focal points can be kept at optimal if the total 'social cost' over the region as a whole is kept at minimal. 'Social cost' of transportation includes those resources also which are consumed in transportation of traffic, from one end to the other. In case of good's traffic, the transport intensive raw materials—inputs and output—are regarded as "social cost" of transportation.

Usually the market price and the opportunity cost of factor of production (inputs) are different. Optimal efficiency in allocating the country's scarce resources can be reached if their opportunity cost is evaluated before. However, it is rather difficult, to make a comprehensive cost analysis to ensure a fair allocation of traffic by different modes of transport taking into consideration the various factors. This is particularly so,

¹Wealth of Nations (1976), Bk. I, Chap. iii.

when the new 'distribution cost' concept which is thought to be the most effective way of door-to-door shipment and delivery of goods, as to replace old transport cost concept¹.

Planning of Transport in India

There have been significant developments in transport since the commencement of the First Five Year Plan, when efforts were largely made on rehabilitation and replacement of worn out assets. During the Second Five year Plan, capacity of the railways and other transport media was enhanced. The development of roads and road transport received a fillip to meet the relatively more dispersed traffic requirements all over the country. The transport capacity was further increased in Fourth Five Year Plan. During the first Three Five Year Plans and the three years of the Annual Plans (1966-69), the investment in transport and communications was nearly 23.6 per cent of the total outlay in the public sector. During the Fourth Five Year Plan, this share came down to 20.3 per cent.

The extent of economic development of a country or region is very precisely judged by the nature and the extent of communications which exist there. A proper and efficient management of forests depends on a good system of communications. Wide roads with good surface and bridges and culverts which are safe for the loaded capacity of vehicles are necessary for the exploitation of forests. Telephone lines are also essential for communication of message particularly for prevention of fires and also for routine jobs.

Forestry development depends more or less on the accessibility of terrain. The weight of unprocessed wood in relation to its value is high. Increase in transportation costs with distance, road conditions and other factors which reflect on costs per kilometre are some agents to limit the harvest to some valuable species alone. As the demand for wood increases and more valuable species are unable to fulfil the increased demand, the price of the raw material increases on account of the shortage of raw material, the marginal species which were not valued high enough to cover the initial costs of road building etc. become profitable to be exploited. However, after the

¹Locklin, D. Phillip—Economics of Transportation, 7th Edn. 1972.

establishment of road system, other marginal tree species may be logged at a profit. Road standards too affect wood transportation costs through weight limitations. Usually the roads in developing countries are of a low standards. Therefore the load limitations are correspondingly low with high costs per tonne-kilometre.

This relationship is illustrated by the following:—

India possesses about 5 per cent area of coniferous species. But owing to the lack of road system in the Himalaya, the coniferous forests are regarded as inaccessible as these cannot be exploited in the absence of good transport system.

Many roads which open up forested areas for timber operations are likely to make accessible the additional agricultural lands and vice-versa. This combination reflects on social benefits to justify the project. Such evaluation must keep in mind the total rural resources. Transportation development in developing countries are often prepared on the basis of attaining point-to-point transportation between cities and inter regional connections neglecting the rural resources. This is on account of a lack of sound data on these resources and their potential commercial values, for local industry and use, and export.

The cost of providing access to forests must consider the opening up of schools, services, energy sources and other infrastructure. Their absence tends to slow down the rate of rural development and affect the forestry sector.

Transportation is the highest single cost of delivered forest products. Transport cost cannot be easily curtailed, as the forested areas are usually the most inaccessible. The existing road system usually connects the major cities to the total neglect of rural areas. Usually the feeder roads of inferior standards are constructed at low costs to serve the agricultural areas. Such roads are not properly maintained. There are also problems of intermittent transport in those tropical forest areas which have heavy rainfall.

All resources should be taken into consideration while planning for transportation. This requires full knowledge of forest resources which may be considered alongwith other resources. Forest resources as well as agricultural resources

need to be developed side by side. Both these resources need close coordination. This type of combination is needed to justify a project as a part of rural area development.

Processing plants must be constructed as close to the source of supply as possible. This factor is often overlooked. Processing of raw material decreases weight and increases value. Plant location in relation to timber supply and transport has often been inadequate.

Most developing countries lack domestic market size to support wood processing plants with the economies of scale for efficient operations. Therefore the regional and inter-regional markets are to be relied upon. Increased exports mean greater use of ocean transport facilities.

Lack of modern port facilities, including adequate storage, has often contributed to high costs. The developing countries are often short of deep water ocean ports. This factor gives rise to longer overland transport of wood products with consequent higher costs.

As in general, the problem of transportation in forestry is an important one in man's life. Exploitation of forest products varies in direct proportion to the transport facilities. Thus there is a positive correlation between them. In India modern mechanised means of transport are insufficient plains while in hilly regions abounding in undulating ground with steep slopes and deep valleys even primitive means of transport are lacking. On the whole, both ancient and modern means of transportation are being employed in the forests in India today.

Unlike the Indian Railways which are controlled by a single authority in respect of administration, financial and technical responsibility, the roads in India are under the decentralised administrative control at different levels of self-Government, viz. Central Government, State Government, Zila Parishad, Block Samities, Village Panchayats and Municipalities. Though in India statutory authority over roads has been decentralised from national to local level, integration of national and local plans for development of roads is done through delegation of executive powers by the higher to the

lower tiers of self Government. The higher authorities cooperate with the lower authorities in shouldering the responsibility in respect of financial and technical know-how. Road development plans may indeed be an exercise in integration of local and national road development plan in India.

According to Planning Commission, "there are areas in India which have developed rapidly without railway lines, based solely on the road system." The road length in India rose to 1.48 million kilometres in 1976-77 as against 1.29 million kilometres in 1970-71. The surfaced and unsurfaced roads were in the ratio of 35% and 65%. Compared to the area of the country, our surfaced road length is just one-fourth of that of Ceylon. There are three million motor vehicles including two and three wheelers but in terms of the number of people to be served, our vehicle strength is nearly one-fourth of Ceylon and one-eighth of Thailand. The road freight traffic in India in 1976-77 was 76 billion tonne-kilometre as compared with 35 billion in 1960-61. In the total volume of rail and road freight traffic, the share of roads increased from 28 per cent to 33 per cent during this period. As against 42 per cent sixteen years ago, the share of passenger bus traffic rose to 61 per cent of the total in 1976-77. However, the details concern 1970-71.

The total road length under various levels of Government of India in 1970-71 was 1,287¹ thousand kilometres. Of this only 407 thousand kilometres were surfaced. This means that unsurfaced roads were nearly twice of this length.

The forest roads are about 7.7 per cent of the total road length but the surfaced roads in the forests are nearly 0.9 per cent of the total surfaced roads in India. It reflects that the major part of roads in the forests are unsurfaced. The control and management of road lengths in India in 1970-71 were divided among the various tiers of self-Governments:—

National Highways

These are generally those roads which connect the national capital with the state capitals, major port towns, border areas

¹BASIC ROAD STATISTICS—1970—Transport Research Division, Ministry of Shipping and Transport Government of India, October 1972.

Table-35 Road Length in India-1970-71
(000 kms)

Name of the authority	Surfaced	Unsurfaced	Total
<i>Central Government</i>			
(1) Roads declared as National Highways	23	1	24
(2) Roads under Military Engineering Service	2	—	2
(3) Roads under the Railways	1	—	1
<i>State Governments</i>			
(1) P.W.D. Departments	241	93	334
(2) Forest Departments	4	97	101
(3) Irrigation/Electricity Departments	2	33	35
<i>District/Local Bodies</i>	72	253	325
CD & NES Blocks	—	376	376
<i>Urban Areas</i>			
(1) Municipalities, Cantonment Boards, Port Trust and Other Statutory bodies in Urban Areas.	62	27	89
Total	407	880	1, 287

etc. These are meant to provide the Central Government an uninterrupted transport alternative to railways for the purpose of inter-state and national transport and trade and national defence and internal security.

At present there are 44 National Highways in the country but the Central Government is empowered to declare or omit any highway as National Highway under the National Highways Act, 1956. The Central Government controls and manages the national highways by delegating any of its functions in relation to the development and maintenance of national highways to the Government of the State in which the national highway is situated or any other authority subordinate to the Central or State Government under the Act. The Central Government then calls for periodical inspection reports and also reports on works carried out on the national highways. The State Public Works Department concerned is responsible for construction and maintenance of National Highways.

Apart from National Highways in the country, the Ministry of Shipping and Transport, Government of India is also responsible for the development and maintenance of other roads in the Union Territories while the execution is done by Union Territories Public Works Department concerned.

Roads Wing—Ministry of Shipping and Transport

The Road Wing of the Ministry of Shipping and Transport administers the roads. Some of its regional offices are located in the States of Bihar, Maharashtra, Uttar Pradesh, Karnataka, and West Bengal. These offices exercise on the spot control on the projects concerning the Central Government. The Roads Wing also administers the Central Road Fund and other funds approved by the Centre for development and maintenance of National Highways and other State Roads. The Roads Wing also acts as a repository of technical information on roads and bridges.

Roads administration under other Central Ministries

(i) Roads under M.E.S.

Roads are constructed and maintained by the Military Engineering Service in the military area. These are financed by the Ministry of Defence.

(ii) Roads under Railways

These roads are constructed, maintained and financed by the Ministry of Railways.

(iii) Roads in Backward Areas

43 Special Multipurpose Tribunal Blocks have been set up under the Centrally sponsored programme for intensive development of roads in backward areas.

(iv) C.D. & N.E.S. Roads

The Public Works Department of the State maintains these roads with the public participation by way of Shramdan, Bhoomidan, Sampatidan, etc.

(v) Cantonment Roads

Cantonment Boards construct and maintain all cantonment roads serving the civil areas. The Ministry of Defence provides finances for the construction of such roads.

(vi) *Border Roads*

A Border Roads Development Board has been set up under the Chairmanship of the Prime Minister. The Defence Minister is its Deputy Chairman. This is done with the sole intention of accelerating the economic development of the North and North Eastern Border Areas. The Cabinet, Foreign, Defence and Home Secretaries are its other members. The Board lays down policy in respect of border communications, prescribing priorities and specifications and also fix the responsibilities of agencies with the execution of the projects.

An ex-officio Joint Secretary of the Ministry of Shipping and Transport is the Secretary of the Board. Over and above a technical organization works under the Director General of Border Roads.

Roads Administration Under State Governments

The States are made wholly responsible for the development and maintenance of :—

(i) State-Highways connecting the National Highways or the highways of adjacent States, district head-quarters and important cities in the States.

(ii) District roads connecting among themselves with one another or with other highways and railways serving the areas of production and markets in the district.

(iii) Village roads connecting villages and groups of villages with one another and with the nearest district road, highway, railway or riverghat.

(iv) Roads maintained by the Forest and Irrigation Departments.

State Highways are generally under the charge of the State Public Works Departments headed by a Chief Engineer. Some States e.g., Tamil Nadu and Andhra Pradesh, have separate Highway Departments to look after the development and maintenance of highways. The department comprises a number of circles each responsible for a definite region. Generally a Superintending Engineer is incharge of a circle. Each circle is further divided into divisions which are controlled by Divisional or Executive Engineer. Each division consists of several sub-divisions.

The roads maintained by Forest Department and Irrigation Department are entirely under the control and supervision of the department concerned.

The Indian Railways

The Indian railways' network is owned and managed by the Central Government with the exception of 207 kilometres of narrow gauge branch lines. Non-government bodies own and work them.

The Indian railways operate on three gauges—the broad gauge (1.676 metres), the metre gauge (1.000 metre) and the narrow gauge (0.762 metre and 0.610 metre). The length under each gauge on the 31st March 1977 was as under :—

The railway length is distributed among different railways under Broad gauge, Metre gauge and Narrow gauge as follows :—

Broad gauge, Metre gauge and Narrow gauge railways cover about 50 per cent, 42 per cent and 8 per cent route kilometres in the country. Northern railways, cover the longest route, viz. 17.8 per cent while the Western railways occupy the second

Table 36

		Railway Route Kilometres—India	
		<i>Route Kilometres*</i>	
		1973	1977
Broad gauge	...	30,126	30,871
Metre gauge	...	25,548	25,512
Narrow gauge	...	4,475	4,279
Total		60,149	60,662

place in length, viz. 17 per cent of the total railway route. Southern railways cover the third position with 12.6 per cent of the total railway route in the country. South Central railways are the rightful claimant for the fourth place while Central railways occupy the fifth place in order of merit. The main characteristics of Eastern and South Eastern railways are

*Indian Railways Annual statistical statements 1972-73 and 1976-77.

Table 37

Distribution of Railways in India, 1976. (Kilometres)

Railways	Broad gauge	Metre gauge	Narrow gauge	Total	Percentage
1	2	3	4	5	6
Central	4,840	382	670	5,892	9.7
Eastern	4,098	—	131	4,229	7.0
Northern	7,023	3,428	259	10,710	17.8
North East Frontier	639	2,901	88	3,628	5.6
North Eastern	163	4,941	—	5,104	8.5
Southern	2,585	4,869	148	7,602	12.6
South Central	2,918	2,873	370	6,161	10.2
South Eastern	5,521	1,332	147	7,000	11.6
Western	3,084	6,118	1,134	10,336	17.0
Total	30,871	26,844	2,947	60,662	100.0

that there is no metre gauge railway line there. North Eastern railways are characterised not to have any narrow gauge railway line there. Central railways have 82 per cent broad gauge, while Eastern railways have 96 per cent broad gauge. Northern and South Eastern railways have 63 per cent and 79 per cent broad gauge lines respectively. Thus Central, Eastern, Northern and South Eastern railways are predominantly occupied by broad gauge line. North Eastern railways have 96 per cent metre gauge, North East Frontier covers 79 per cent of metre gauge railways while Southern and Western railways have 64 per cent and 59 per cent of metre gauge railways. Thus it is clear that metre gauge dominates in North East Frontier, North Eastern, Western and Southern railways.

Pattern of Movement of Raw Material

No details about the movement pattern of timber, bamboos and firewood were available with the Ministry of Food and Agriculture but detailed information about movement of

these commodities were available for the period 1965-66, 1970-71 and 1976-77 in respect of railways shown in Table 38.

A look at these figures reveals that in general the movement of wood by railways has gone down while the expected trend must have been the increasing movement by railways. It is backed by some reasons. (1) The road transport has come to play a greater part in the movement of wood in the country. (2) As far as firewood is concerned, the recorded statistics of production were available only to the extent of 9 per cent of the total production. The unrecorded production of 110 million tonnes of firewood was considered as having been consumed at the place of extraction which required no transportation at all. It is not possible to work out the pattern of movement of firewood by road, river and sea as the extent of firewood consumption in each district in the country is not known. There is no information about the movement pattern by road, river and sea from any source. However, presumably no road transportation of firewood is involved beyond a distance of about 200 kilometres and it is negligible in case of river/sea transportation. However table 39 gives an idea of movement of timber by various modes of transportation in 1965-66.

(1) Andhra Pradesh imports from Assam, Bihar, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu and exports to Karnataka, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal and Delhi.

(2) Assam imports from Madhya Pradesh, Manipur and Tripura and exports to Andhra Pradesh, Bihar, Gujarat, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and Delhi.

(3) Bihar imports from Assam, Haryana, Himachal Pradesh, Madhya Pradesh, Maharashtra, Orissa, Punjab, Uttar Pradesh and exports to Andhra Pradesh, Haryana, Gujarat, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Uttar Pradesh, West Bengal and Delhi.

(4) Gujarat imports from Andhra Pradesh, Assam, Bihar, Karnataka, Kerala, Madhya Pradesh, Orissa, Punjab,

Table 38¹
 Originating Tonnage of Timber, Bamboos and Firewood (Including Charcoal), on the Various
 Zonal Railways.

Railways	Timber		1976-77	Bamboos		Firewood			
	1965-66	1970-71		1965-66	1970-71	1976-77	1965-66	1970-71	1976-77
1. Central	327	284	176	33	24	45	308	218	47
2. Eastern	191	130	107	132	65	61	86	93	56
3. Northern	314	232	225	5	7	8	54	40	18
4. North-Eastern	448	407	282	28	19	11	181	130	102
5. North East Frontier	270	480	411	38	133	210	18	15	19
6. Southern	315	341	232	47	28	7	207	157	93
7. South Eastern	605	610	671	633	578	413	200	253	324
8. Western	125	63	18	21	8	2	160	81	30
9. South Central	93	100	62	32	42	35	208	212	140
Total	2,688	2,647	2,184	969	904	792	1,422	1,199	829

¹Supplement to Indian Railways Report 1965-66, 1972-73 and 1976-77

Table 39¹

Pattern of movement of timber by various modes of transportation in 1965-66.

('000 cubic metres)

State	Production	Imports (+)	Exports (—)	Apparent Consumption
Andhra Pradesh	235	226	81	380
Assam	304	62	180	186
Bihar	533	188	369	352
Gujarat	183	191	24	350
Haryana	21	574	220	375
Jammu & Kashmir	414	33	206	241
Karnataka	519	27	412	134
Kerala	300	117	323	94
Madhya Pradesh	1,416	63	873	606
Punjab	60	564	360	264
Rajasthan	66	108	17	157
Tamil Nadu	37	296	34	299
Uttar Pradesh	1,019	360	602	777
West Bengal	243	779	34	988
Total	5,350	3,588	3,736	5,203

Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal and exports to Haryana, Madhya Pradesh, Maharashtra, Rajasthan Uttar Pradesh.

(5) Haryana imports from Bihar, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Orissa, Punjab, Rajasthan, Uttar Pradesh, West Bengal and exports to Bihar, Madhya Pradesh, Maharashtra, Orissa, Punjab, Uttar Pradesh, West Bengal and Delhi.

¹Commodity Transport Studies, Timber and Timber Products, Joint Technical Group for Transport Planning Commission, December 1967.

(6) Jammu & Kashmir imports from Punjab and exports to Punjab and Maharashtra.

(7) Karnataka imports from Andhra Pradesh, Kerala, Maharashtra, Madhya Pradesh, Punjab, Tamil Nadu, Uttar Pradesh and exports to Andhra Pradesh, Haryana, Gujarat, Kerala, Maharashtra, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, Goa, Daman & Diu and Delhi.

(8) Kerala imports from Karnataka, Tamil Nadu, Andaman & Nicobar Islands and exports to Andhra Pradesh, Karnataka, Haryana, Gujarat, Madhya Pradesh, Maharashtra, Tamil Nadu, Uttar Pradesh, West Bengal and Delhi.

(9) Madhya Pradesh imports from Assam, Bihar, Haryana, Gujarat, Karnataka, Kerala, Maharashtra, Orissa, Punjab, Uttar Pradesh, and exports to Andhra Pradesh, Assam, Bihar, Haryana, Gujarat, Karnataka, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and Delhi.

(10) Punjab imports from Assam, Bihar, Haryana, Himachal Pradesh, and exports to Andhra Pradesh, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Madhya Pradesh, Maharashtra, Karnataka, Uttar Pradesh, West Bengal and Delhi.

(11) Rajasthan imports from Assam, Bihar, Gujarat, Madhya Pradesh, Maharashtra, Karnataka, Orissa, Punjab, Uttar Pradesh and West Bengal and exports to Gujarat, Haryana, Uttar Pradesh and Delhi.

(12) Tamil Nadu imports from Andhra Pradesh, Assam, Kerala, Madhya Pradesh, Maharashtra, Manipur, Andaman & Nicobar Islands and exports to Andhra Pradesh, Gujarat, Karnataka, Kerala, Maharashtra, Uttar Pradesh and Delhi.

(13) Uttar Pradesh imports from Andhra Pradesh, Assam, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, West Bengal and exports to Delhi and all these

States except Andhra Pradesh, Assam, Himachal Pradesh, Kerala and Tamil Nadu.

(14) West Bengal imports from Andhra Pradesh, Assam, Bihar, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Uttar Pradesh, Andaman & Nicobar Islands and exports to Gujarat, Haryana, Rajasthan, Uttar Pradesh and Delhi.

The above table clearly shows that the producing States are not the consuming centres of timber. Haryana, Punjab and Tamil Nadu produce the lowest quantity among the States but they consume quite big quantity of timber. West Bengal tops the list of consuming centres. Second comes Uttar Pradesh and the third is Madhya Pradesh. It is the concentration of industrial units in the States which makes them use more wood.

After the trees have been harvested the transportation of these commodities involves three phases, viz. movement from stump to road, movement from road to railhead or to the depot for onward despatch to the consuming centre by road and the movement on the permanent lines of transportation either by rail, road river or sea to the final destination of consumption. This chapter deals with the first two phases. The third phase is not to be considered here. The first phase, i.e. movement from the stump to road is usually done by manual labour, carts, sliding or skidding. The second phase of movement, i.e. from road to the railhead or the depot is usually done on forest roads. The Forest Department constructs and maintains forest roads, and develops them whenever necessary. Development of communications is an essential part of its management practice. The main benefits which are likely to accrue are as under.

It will:—

1. facilitate opening up of hitherto inaccessible forest areas specially in the hilly region.
2. help increasing the percentage of conversion of timber in the log form.

3. reduce the exploitation cost of timber.
4. help accelerating the pace of transporting the forest produce to markets and factories.
5. reduce the damage and losses to the minimum which are inherent in river transport system and will make the rivers comparatively free and safe for generation of hydro-electricity.
6. facilitate to manage and inspect the forest intensively.
7. help creating increased employment potential to boost up the general economic development of the region on account of the availability of general transport system and create additional amenities to the villagers in the vicinity.
8. increase tourist traffic for the utilisation of the recreational value of forests.
9. create facilities for exploitation of those species which have not been exploited so far as they have proved to be unsuitable for river transport.

(A) Forest Roads and Tramways

The Forest Departments in the country maintained about 101,000 kilometres of roads in 1970-71. It comprised 4,000 kilometres of surfaced roads and 97,000 kilometres of unsurfaced roads. The unsurfaced roads consisted of bridle paths and other paths also. A major portion of such roads were fair weather roads which have been surfaced either with earth or gravel. These roads serve for extraction of forest produce and inspection of forests during the fair weather only. They are completely useless during rains. Every year heavy repairs have to be undertaken after the rains, as the road surface is generally badly eroded and scoured. Therefore maintenance gangs are required to keep these roads in good working condition throughout the working season. The condition of bridges and culverts is also far from satisfactory. There is no proper distribution of roads all over the forests. The distribution of roads differs from State to State. For example, the sal region in Uttar Pradesh has a higher density of road while the hill and

the southern regions have comparatively poor density of roads.

The converted trees or bamboos are generally carried by coolies on their backs or dragged by animals to the nearest cart road or dragging path, to link with the main road, or, in the case of bamboos, with the nearest floating stream. Though carts are not expensive, dragging is the cheapest method for the smaller forms of timber where price is not affected by the damage thus caused and also for the shorter grades of bamboos. Thus some kind of cheaper timbers which are popularly known as 'tors', small 'karies', 'burgas' and 'gaulas' and the cheaper class of bamboos are largely dragged out of the forests. Recent road development in the forests have allowed some exports by motor trucks.

The bhabar or sabai grass contractors employ every type of transport for their bales of bhabar which is transported to different places in the country. In Uttar Pradesh camels are the cheapest and most favoured means of transport¹ but the motor transport is replacing such transport very rapidly.

Formerly tramway was also being used to a greater extent for transporting the forest produce in India but now it is not economical due to the advent of quicker and cheaper means of transport. Such tramways are being replaced everywhere in the forests of India. For example, there were two tramways each 24 kilometres long approximately for the extraction of forest produce in the Gorakhpur and Haldwani forest divisions in Uttar Pradesh. The Haldwani Forest Division Tramway has, however, stopped working owing to competition by road transport.

(B) Waterways

Whenever possible, bamboo contractors use rivers in the country for rafting their bamboos. For example, the river Ramganga and the lower part of the river Mandal in the Kalagarh division, Uttar Pradesh are used for this purpose. Formerly it was a general practice to combine sal timber along

¹Working Plan for the Saharanpur Forest Division—J.R. Singha, B Sc, I F S., Dy. Conservator of Forests, Uttar Pradesh.

with these rafts but with the advent of better roads and cheaper transport by land this system has been discontinued.

All timber exported to the plains from Chakrata division, is floated down the Tons and Yamuna rivers to the boom at Dhakpathar a few kilometres below their confluence. Some small amount of timber is then taken to Dehra Dun by road from there but a major part of it is floated down the Yamuna river to Tajewala. It again goes down the Western Yamuna canal to Jagadhri on the Northern Railway. Wet slides and 'telescopic' floating are frequently used in all the chir and deodar areas to bring the timber to the boom. The carriage of timber on man's back is known as 'Dhulan'. It is the only type of transport of timber from far-off places in the forest where 'telescopic' floating or wet slides can not be used.

Thus transportation of logs, sawn timber and fuel which are the main products of the forests, can be divided into two viz. (1) Land Transportation and (2) Water Transportation.

(1) Land Transportation

(a) *Of Round Timber By Road:* The following methods are in common use for this purpose.

(i) *Dragging by Animals:* Elephants, buffaloes, horses, mules and bullocks are the common draught animals used for dragging and extraction of logs in India. Out of these the first two are the strongest of all. Forest paths are not usually used for dragging of timber or bamboos but rough earth roads are constructed by felling trees, and removing stumps and other obstacles. It is advisable that loads should not be dragged on slopes over soft ground as far as possible. The cordway roads should be constructed by half sinking round billets of suitable size across the road at an interval of few feet. In other cases round billets acting as rollers are put in front of the logs meant to be dragged or rolled. The workers are required to put these billets from behind in front of the logs to move them fast. Efficient working of the man at rollers can move the logs at a fast speed.

The forest fibre ropes and chains are commonly used for dragging of timber. The chains are tied to the logs in different ways. Sometimes large ring-bolts with a very coarse thread

are screwed into the holes cut into the log nearly at a distance of a foot or so from the end. A very common method of dragging the logs is to pass the chain round the end of the log, driving in a small iron bolt just in front of the chain to prevent it from slipping. The logs are commonly dragged by cutting drag-holes near the end of the log. Then the chain is allowed to pass through them. The drag holes then can be used for the purpose of rafting.

'Where logs have to be dragged on steep slopes, a system of pully blocks can be used'¹

'Dragging is not really a very efficient method of extraction but is often the only way possible. It is, however, destructive to road surface and should not be permitted on roads if other forms of transport facilities are available'.

(ii) Extraction by Means of Carts and Pairs of Wheels: Dragging should always be discouraged if cart road is available. A cart can easily carry double the load which is possibly dragged by an animal power. The time consumed in cart transport is much less than taken by the animal. The country cart can carry small logs quite comfortably. It usually comprises a pair of wheels, a strong wooden block, concaved at the centre. It is fixed on an axle, and a pair of shafts. In other countries logs are transported by hanging them in chains below the exles of one or more pairs of large wheels.

(iii) Extraction by Rolling: It is easy to construct rolling roads in plains on flat ground or even gentle slopes. It needs only clearing all the hindrances from the desired route.

Either elephants or men perform the rolling of logs. Logs roll easily with the help of strong wooden levers but the Kent-hook or American peavy log rolling devices are the best. Since the construction of roads is expensive, the log rolling schemes requiring a long constructional work of roads should be discouraged. A combined system both of logging roads and some other method is practised on the steep slopes in the Himalaya. The roads work as feeders to the site for earth chutes. These are just ordinary roads without difference in construction technology. The main difference is that poles are

¹Manual of Indian Forest Utilisation—W.H. Trotter, 1940 Edition.

sunk into the ground in two parallel rows to work as rail for effecting rolling facilities there. Such roads should be discouraged on steep slopes as the logs would roll too fast to be controlled. Thus rolling is a dangerous job if handled carelessly. It is preferable if one log is allowed to move at a time in one section of the road. Rolling should preferably be done on contract basis. For example payment might be a certain amount per cubic metre on delivery at the depot. In this case the Department constructs the roads, chutes and check-walls for the purpose.

(b) Of Sawn Timber and Firewood. This is done by various means by road as follows:—

(i) The carts are used for carrying sawn timber and fire wood in the plains of Uttar Pradesh. They are well known throughout the country it being agrarian. They are the cheapest means of transport in India.

(ii) Pack animals such as donkeys, mules and horses are always preferred in those regions where carts are neither available nor usable on account of bad roads. Sleepers and baib grass are carried on camels backs in Northern India. The baib grass is collected at different centres such as Hardwar in U.P. and so many other centres in the country.

(iii) Sleepers and scantlings from the forest are carried on human back to the launching or other depots. This is the usual form of transport in the Himalaya. Rough paths entailing very low cost are constructed for this purpose. Coolies carry scantlings and sleepers on their back on contract rate to the depots. Payment is made according to the size of the timber and the length of the path. Since supply of coolies in the hilly areas is scanty and cartage by them is expensive, this method is being replaced by overhead transport wherever possible.

(iv) The converted timber is also transported by trucks. But there are two kinds of difficulties in this type of transportation system. (1) it is expensive and (2) it is not advisable if circumstances are unfavourable owing to lack of good motorable roads. The use of motor transport in India is not common as there are some few thousand kilometres of motorable roads in

the forests. It is nothing to speak of motorable roads in the forests, they are not sufficient to serve the needs of urban and rural areas in the country. Thus the roads are not a sufficient means of transport employed in the forests in India. Though motor transport is not sufficient in the forests, it is the best means to carry timber from the saw mill to the market in India

(c) Of All Wood by Tramways. Tramways are very often used in the forests for the extraction of converted timber and for its transport both in Europe and America. The development of forest tramways has taken place to some extent in India too. This method was put on trial in two divisions, Haldwani and Gorakhpur in Uttar Pradesh. As it has already been mentioned the system has been ousted by the competition of motor transport in Haldwani division, though it is still working in Gorakhpur division. Though motor transport is not usually cheaper than the tramway transport, it proved so in Haldwani division. The cost of loading the produce in the forests and then unloading it at the rail head and then again loading the same in the railway wagons and then finally unloading the consignment at the consuming centres amounts to so much that it is better to load timber in the trucks in the forests and unload them at the consuming centres straight away. Thus trucks had an edge over the tramway in Haldwani division. But it is a general practice in Gorakhpur division to auction small blocks to individual contractors, who are unable to invest much of capital to work their small blocks. Contractors have to work these blocks without mechanized transport system of their own. Therefore the tramway is still working profitably in the division. However there is no possibility of tramway becoming popular in India, as the system of felling trees is the selection system in which scattered trees are felled. Other systems of felling are not generally practised in this country. In many localities in the forests laying down tramways is not advisable as it would entail high construction cost of many bridges.

The following conditions should be fulfilled before a forest tramway can be laid down to work profitably.

- (1) The produce must have regular flow and sufficient demand.
- (2) The tram line should be laid down in such places from where export of a sufficiently large quantity of produce is needed.

(d) Of Timber By Slides. "Log slides" were commonly used in the Himalaya once and large outturn justifies their construction. The earth chute in use which consists of trough scooped out down a hillside is the lone type logslide. Small stream bed can serve the same purpose if they are shallow without too many rocks. But sliding in earth chute needs a very careful attention to avoid damage by smashing one into the other from above. Strong check walls where gradient permits are needed to keep the logs under control. Check walls are made by sinking a row of logs vertically in the ground to form a palisade. Strong check walls are also necessary to change the direction of the logs in sliding.

When slides are used to carry sawn timber, they are termed as (i) dry slides and (ii) wet slides.

(i) Dry Slides. The timber has to move on its own weight under this system. Such slides are full of disadvantages which debar their common use in India. They are used only for short distances where it is necessary to put the scantlings into a river from a depot on a steep bank above it. The disadvantages are as listed below :—

1. There is more wear and tear to the timber as compared to the wet slides.

2. Since the timber slides down on its own weight, it has a tendency either to travel very fast or to stop on the way altogether.

3. These slides are undivisible into sections. They are to be worked in one section as the timber has to be stopped in hollows dug in earth at the foot of each section.

4. It is impossible to put powerful brakes to control the speed of the sliding timber.

The sole advantage of dry slides is that they do not require water-tight joints as it is necessary in the case of wet slides. They can be used in the absence of water. Their use

for long distances is not recommended at all. They can, however, be used for short steep lengths under favourable conditions.

(ii) Wet Slides. These slides have been in great use in the Himalaya for a long time. They are still in use in that region for extracting railway sleepers and other sawn timber. These are supplemented by portable wire ropeways to some extent. Water is the motive power used for these slides in addition to gravity.

A wet slide comprises a rectangular trough constructed with the help of sleepers. After the work is over these sleepers are removed for export. Though leak proof joints are impossible these can be made as water-tight as possible. This method has been found very successful if there is a constant flow of water down the slides. The deeper the water the better it is because it works as brakes on steep slopes and increases the speed of the sleepers on low gradient to move faster than water. The water flows comparatively at a slower speed if the length of the slide is greater. Though a slide can conveniently be worked to a limited length without supplementing the water supply, it is better to divide it into a number of control-sections. The slides differ in length to a great extent but 600 metres is a convenient length of the slide. Each control section of this length will get a fresh water supply. First of all the timber is allowed to enter a pool, then it is directed down the first section. At the end of this section there is another pool for the discharge of scantlings. The first pool serves to supply water to the second section. This procedure goes on repeating for other sections till the last section discharges the scantlings into the stream.

The construction, operation and maintenance of wet slides is a very expensive process. Over and above these slides face great danger from floods and landslips etc. Break-downs are always anticipated. Their construction needs skill. Therefore it is suggested that no expensive scheme should be undertaken unless every possibility has been explored thoroughly. It becomes very difficult to operate a slide in the rainy season as the water in the stream fluctuates to a great extent and construction of a dam is impossible at that time.

A slide 'mistry' can easily construct about 150 metres with the help of about ten coolies in a month.

The Working of a Slide.

(1) The slide should be repaired every morning before beginning the work.

(2) The scantlings should be moved with some time interval to avoid congestion. It is estimated that four scantlings per minute work out very well for the slide.

(3) Usually batches of the same size, class and species of timber should be floated down the slide

The construction cost of a wet slide varies between Rs. 3.25 to Rs. 4.87 per running metre. The cost is as much as three times the usual cost on incline rock and twice on high trestling. This method is comparatively cheaper than the coolie transport, but it is rather expensive as compared to the ropeways or 'telescopic' floating. However, the last methods are not very efficient means of transporting timber as scantlings are open to more damage under the first method. Other things being equal, wet slides are generally found more useful if topography is otherwise for ropeways. Unfavourable conditions of the stream, make 'telescopic' floating impossible.

(e) Of Timber By Gravity Ropeways. These are very commonly used in European countries and recently their use has been found on an increase in India also but not to a great extent enough to be mentioned. It is because the sale of coupes to the contractors is very widely spread in geographical extent. Since the contractors are unable to purchase the ropeways, and even if they do so they are not sure of extracting the produce from the same locality in the succeeding years. In addition, the extraction of heavy logs by ropeways in the Himalaya is not an easy job because of handling of heavy cables necessary for transport of logs.

The gravity ropeway usually consists of a wire cable stretched between two points, on which it is anchored. The cable should have sufficient inclination to force the load to the bottom easily. The load which runs on the cable is attached to a wooden saddle or pulley wheel. A moving control rope is, generally, used along with one or more fixed ropes. The

rope to which the load is attached to descend, controls its speed. This system, therefore, is very useful even on the steepest slopes.

There are different types of ropeways but the system followed in the Northern Himalaya is known as the Donald portable gravity ropeway. This system works on three fixed ropes set parallel to one another at nearly three fifths of a metre interval. These ropes are fixed at two places e.g. top and bottom stations. The control rope which runs round the cast iron grooved shelves is usually lighter and more flexible than the fixed ropes. A long splice joins the two ends. The load hangs crosswise below three fixed ropes by three carriers which are made of pulleys and an attachment to which wire-slings fastened round the load can be hooked. Another wire-sling round the centre of the load is fastened to an 'eye' let into the control rope. Thus the load descends to pull the empty carriers up which hang from another 'eye' let at the lower end of the control rope. The scantlings are removed when the load reaches bottom. Then the empty carriage is attached to the control rope. Simultaneously another load is prepared at the top station. A simple but effective lever-operated hand brake is worked at the bottom station. This system is so simple that it is not difficult to train even local labourers for this purpose. The latest development in this field has simplified the system. Now it works with one rope instead of three. Formerly the cost of the apparatus was very high but the new light 'Sky Master' ropeway costs about Rs. 25,000 only.

The gravity ropeway can easily descend 0.255 cubic metre of green timber weighing about 500 lbs. at a time. The largest span covered in India is 1,445 metres. Usually roping is undertaken on contract basis, a flat rate being paid for each length of the span per scantling. The Department is responsible for erection and dismantling the spans. These operations differ greatly in cost structure e.g. nearly Rs. 250 for erection and Rs. 80 for dismantling.

It can be concluded that gravity ropeways are the most efficient system of transporting timber in the hilly tracts. The delivery system of timber is so good that the scantlings are

quite safe there. Beside, the timber is delivered at the depots at a cheap rate.

(2) *Transport By water.*

Water transport is the oldest method of transporting timber ever known to mankind. This method is the cheapest one in respect of long distances. But now the road transport system which can be extended frequently right upto the felling areas is replacing this system, for it is cheaper and quicker than that of water transport. The timber is safer than in water. There is comparatively less damage to or loss of timber in transit. But inspite of the disadvantages, the waterways—natural or artificial—will always remain a good source of transport of timber. Two different means—floating and rafting—are employed in India in water transport. Floating connotes the drifting down the timber alongwith the current of its own accord. There is no direct human control over the drifting timber under this method. The timber is called a raft when scantlings are bound together into one compact structure before they are navigated down the waterways or even along sea coasts. Floating is advisable in those streams or rivers which are narrow and rocky enough to allow the rafts to navigate. Rafting is always advisable in those rivers which have a tranquil current with wide space for floating purposes. Therefore floating is a common feature in the upper reaches of the rivers while rafting is the order of the day in the lower ones.

(i) *Floating.* Light timber—sawn or round—is floated. The floating of logs is done on extensive scale in Burma and other places. It is no exegeration that nearly all the timber yield, mostly in sleeper form, is brought to the plains from the North-Western Himalaya by means of river transport.

There are a number of factors to be considered before deciding the suitability of a stream for the floating of timber. Usually scantlings have a tendency to float in almost every stream, but logs are more exacting, for which the following conditions must be fulfilled.

(1) The stream just be wide enough so that the timber may move in the waters. There must be sufficient room for the timber to turn round and must not get jammed against the banks.

(2) There should be no hindrance in the river.

(3) The river should have sufficient water at one or the other season so that timber may float easily without breakage.

Special attention has always been paid in Europe to improving the water courses for floating purposes. Elaborate schemes of construction for the improvement of rivers have been undertaken in Europe while such works are often impracticable in India. The rivers in Himalaya require blasting of serious obstructions for improving them. But again such blasting is impossible in the Himalaya which are comparatively of recent origin with soft rocks. Thus blasting of such rocks is likely to prove dangerous to the water course. The streams running through the forests in Burma have been deepened widened and straightened for extraction of the logs in large number. The construction of lateral booms of palisades across their entrances is advisable to avoid collection of timber in the back waters and at the mouths of side streams.

Floating of sawn timber and logs is practised in the Himalayan rivers. Few rivers are however suitable for floating of logs, and the main streams on which the bulk of forests stand are unfit for this purpose. The floating of logs and scantlings in the Himalayan rivers is as follows:—

(ii) *Logs.* Usually the logs are floated in rising water before rains. It is because the logs in the high waters may be able to cross the hurdles easily and reach their destination. But some logs are definitely carried stray beyond the limit of river operations as the booms cannot be kept in position during the high waters in the river. The stray logs are again put on their right track by the swimmers who use inflated buffalo skins for watching the stray logs. Since the requirements of scantlings and logs differ, they should never be floated together. If both float together, logs are liable to damage the scantlings seriously in transit. Scantlings should always be floated at the end of the rains.

By floating the logs at the beginning of the season some logs are definitely carried stray beyond the limit of river operations as the booms are never kept in position when high

water is there. But then the swimmers with inflated buffalo skins, look after the drifting logs. A small 'sweeping' party works on relaunching the stranded logs. During winter, all the logs that have been left at higher levels than the normal flood mark are rolled nearer the stream and are automatically re-floated as the river rises. In this case also logs take years to reach the sales depots. The average loss of timber in transit is decidedly low when worked out over a number of years.

(iii) *Sawn Timber*. There are two main operations involved in the floating of sawn timber.

(1) Floating in narrow nullahas, or 'telescopic' floating.

(2) Floating in the main rivers, or 'sweeping'.

Telescopic Floating. This work is done for the extraction of sleepers and scantlings down the narrow side-rivers (called nullahas), which have rocky and tortuous beds and a great difference in gradient. In these streams there is no water and even during the rains the flow remains ordinarily low in which scantlings and sleepers cannot properly float. Such circumstances make ordinary floating impossible throughout the greater part of the stream. Then telescopic floating is the only method resorted to. Just to make the whole stream suitable for floating rough slides or chutes locally known as 'pathrus' are constructed with the help of scantlings or sleepers themselves. An open framework of scantlings is built between and over the boulders in such a way that a trough of scantlings placed lengthwise side-by-side, can rest firmly on it. The slides may have a number of sections with over-lapping ends. The length of obstacles to be covered is the main consideration in deciding about the sections of the slide. In the case of necessity the stream can be partially demmed at the head of each length of slides, so as to create enough flow of water. As a general rule, a pool has to be constructed at the lower end of each length as well, so that the scantlings may be discharged into deep water and the damage on the ends may be saved.

Often the construction of a slide or chute starts from the launching depots to continue even to down streams. The banks of the stream which need no "pathru" are lined with scantlings to smoothen the floating of scantlings throughout

the stream. The slide is quickly dismantled from the point of beginning and the scantlings floated to the head which continuously extend downstream. Thus the whole 'ghal'—a local name for a complete unit of extraction in floating operation, is finally discharged into the main stream.

These slides have the following disadvantages :—

- (i) The scantlings get damaged on the ends while floating.
- (ii) The whole 'ghal' is at the mercy of the water and the rocks when the stream goes in spate suddenly. At such a time the timber is definitely damaged.
- (iii) This system can be applied only to some selected 'nullahas' which are not very steep.

Concluding it can be said that long rivulets of easy to moderate gradient are suitable for 'telescopic' floating. These are such gradients where the carriage by coolies or the use of wet slides would be too expensive. These gradients are too low for the use of ropeways. A noteworthy fact is that the Himalayan rivulets vary in nature so much so that telescopic floating alone cannot be of great help. This system has to be supplemented with wet slides, or ropeways or even with both.

(2) Sweeping. A very large number of scantlings or sleepers get jammed on account of obstructions such as rocks and sand banks or are caught up in the backwaters while floating in the main rivers alongwith the current. There are some small gangs of coolies forming a sweeping party who try to refloat such timber. Some coolies are engaged and posted ahead of the main sweeping party to look after such points where the sleepers or scantlings usually get stranded in a large number. Their duty is to see that scantlings and sleepers float properly as far as possible. The main party works at the back of the 'ghal'. They have a special responsibility to see that no timber remains behind unfloated in the river. A sweeping party includes a number of people equipped with inflated buffalo-skins. As the timber is nearing the boom the speed of the sweeping has to be regulated very carefully to avoid the force of scantlings from being cast on the boom so that the boom does not get damaged, and to feed the labour engaged

for catching the timber so that they may not be idle but are kept fully busy.

It is most important to judge the correct time for launching the floating operations. In this connection several factors have to be considered before any decision is taken. First of all the timber, which reaches the sales depot first, is likely to get a better price. Secondly the timber can float well when water conditions are fairly well settled and safe. If, on the other hand, the condition of water are unfavourable for floating, much of the timber is likely to go stray. Therefore a correct timing is needed for launching the timber into the river which has some waterfalls etc. Such conditions prevailed in those rivulets which were used for telescopic floating. Too early launching before the rains were properly over, might result in disaster to the timber while undue delay might cause belated arrival at the sales depots and consequently delay in the sale of the whole outturn for the year.

Both—'telescopic' floating and sweeping—are done on contract basis by skilled labour recruited from special districts for this purpose. The timber is carefully checked before launching in the rivers. The contractor then issues a receipt for the stock and assumes its full responsibility. The forest staff has a responsibility to supervise carefully the floating operations if departmental extraction is in vogue. The contractor is paid on the delivery at the boom. The loss in transit is borne by the contractor if it is in excess of a certain percentage—usually 5 per cent—which is allowed to him. Ordinarily enumeration of the timber left behind is done during winter season. This is then stacked above high-water level, ready for re-launching the following floating season.

(3) Rafting. It has already been elucidated that rafting of timber is impossible if the current of the water is rapid and is not free from serious obstacles. The rivers must have both a sufficiently wide channel and its current a moderate speed. Such conditions do not exist in those rivers which originate in the Himalaya until they enter the plains. Logs, scantlings and bamboos are rafted, and sometimes other forest products such as grass is brought down the rivers on timber rafts.

(4) Booms. Booms are stretched across the river to catch the drifting timber of its own upto that time unless the timber is bound into a raft. Fixed or permanent booms which are constructed at a high cost are used in Europe. Such arrangements are impossible in India owing to great fluctuations in water levels and to the size of most of the rivers. Hence booms have temporary character in India. Such booms are kept in position while floating continues but they are dismantled before the rising water of the rivers is likely to break them. Temporary booms float on the water and they are generally so moored to the banks at both ends as to make them lie across the rivers at a slanting position. This position helps the timber to drift towards the banks to some extent and facilitates the landing of timber by covering a large frontage. It reduces the risk of the boom being broken by any increase in the pressure due to rising water or accumulation of timber. The booms have many varieties with elaborate details but the general principle is that the sections are linked together by wire cables. These are in turn, tied to a strong anchorage on the banks. The booms have their permanent anchors only at their upper ends. They lie along the bank if not in use or they may be dismantled and stored. A number of guy-ropes, attached at intervals along with it when it is needed to be put in position, stretch to the opposite bank of the river. The guy-ropes are anchored there to hold the boom in position. They are loosened when the boom is required to be disbanded. Thus the boom swings back with the current and lie along the bank. A 'gate' is kept between the free end and the bank to allow rafts to proceed down-stream when the boom is in position.

The site of the boom must have the following facilities :—

- (1) It must have slow current.
- (2) It must have shallow water to allow tying up the rafts.
- (3) And it must have enough land on the banks of the river for stacking timber during the course of flood.

(4) It is advantageous to select a site where the current has a tendency to drift the scantlings towards the side where rafting is possible.

Generally booms must have a large frontage with due regard to cost structure. They should lie sufficiently deep into the water to prevent the sweeping away of timber by water underneath.

The gangs of labourers swimming on the inflated buffalo and goat skins catch all the timber which arrive at the boom. This timber is then directed to shallow water to be tied up into rafts. Various types of rafts are made on different rivers. In the case of the Yamuna sleepers are placed two deep in rows, the length of the sleepers being at right angle to the direction of the river. Across these, two double rows of the sleepers are then placed lengthwise. The pairs of sleepers in the rows are bound together and also to the sleepers placed lengthwise across them. Grass ropes are used for tying these sleepers. Then these rafts are rowed down by two men using long poles for guiding the rafts and keeping them away from the banks. Some check depots are established in between the booms and the sales depots to have a control and check over the rafts in transit. 'Challans' showing the details of the scantlings of the rafts are handed over to the person incharge of the rafts. These challans are checked against the rafts on every intermediate depot. The work at the boom and the function of rafting and salvaging the timber which is stranded below the boom are always done on contract basis.

Choice of the Method of Transport. Several points are to be borne in mind before deciding about the method of transport to be used in a particular locality. Some important considerations are as follows:—

(a) Cost. The method which is the cheapest should be adopted as far as possible. For this purpose a careful comparative study is essential in respect of the cost of the existing and the proposed method before changing the system. Both capital expenditure and the amount of produce available should be considered. The cost must be spread over the estimated output to find out the working, maintenance and direct charges. Finally, indirect and depreciation charges should be considered.

(b) Loss of and Damage to the Product. A new method should not be adopted if it has a little saving in the direct cost

of transportation and there is increased loss or damage involved in the new transport method. On the other hand that method is recommended which diminishes the loss or damage to the minimum.

(c) The Time Factor. Generally that method which transports the timber to the depot expeditiously should be preferred. An early conversion of those timbers, which are easy to saw green is advisable.

(d) Labour. Labour saving devices should be adopted in those areas where there is scarcity of labour or draught animals. Introduction of mechanical transportation tends to bring down the local cost of carting and effect a saving in labour wages.

(e) Forest Improvement. The opening up of inaccessible forests and improving them and thus making them more accessible must be considered. The introduction of a good system of roads benefits a forest estate indirectly. Sometimes the fixing up of a ropeway helps open up these forests which appear to be inaccessible otherwise.

(f) Markets. Extraction on a large basis should not be taken up in hand in those localities where only a local fluctuating demand exists. Mechanical means of transport need more capital outlay and therefore they are expensive. Such method should be tried in those areas where there is a good outturn with definite and steady markets.

(g) Influence of Topography. The adoption of a suitable method of transport depends on the topography of the country. For example, the use of Forest Railways cannot be permitted in hilly regions. They can serve the forests in plains. Aerial transport is unnecessary on level ground; it is advisable to have it in very hilly regions where railways and other means of transport cannot work.

CHAPTER 12

Role of Forests in Economic Development

It is relatively a new development to plan the forests with the sole object at perpetuating and improving them in the world. Man has been continually active to destroying and burning the forests repeatedly in order to carve out his fields for expansion of agriculture throughout the ages. Thus this activity reduced their productivity and area as well. A heavy pressure was put on them by extracting constructional timber and fuel.

The belief that forests were inexhaustible proved another factor of destruction and deterioration. Forests were often treated to be a nuisance in the way of development. In case they were found an asset, lavish use of them was the order of the day. Even after this type of destructive treatment about 60 per cent of the forest resources of the world remained untouched due to their inaccessibility.

Formerly forests used to be managed for purposes of games but the timber famine, resulting from destruction of forests to feed the war supplies during the 17th century, compelled the people in Central Europe to change the attitude and practice of forestry management for wood. This gave birth to modern forestry.

Modern Forestry

There are many ways to define forestry but it is chiefly the management of forests and forest lands for the continuous production of goods and services. The art of forestry is based on scientific information applied to management of forests with due regard to economic and social consideration. Biological, physical and social considerations, mathematics, engineering and philosophy—all have a great role in making forestry a successful art. Forestry has developed into a profession requiring special training on account of all these complications.

Forestry deals with production and exploitation of services and goods—all possessing social and economic values both tangible and intangible. Forestry is capable of converting anticipated returns into present worth.

Modern forestry is based on two important aspects—multiple use and sustained yield. When forests are managed for more than one purpose it is called multipurpose forestry, e.g., timber production, watershed protection and also recreation. It is impossible to maximise the yield from all these uses. Therefore the best combination of uses is to be determined in the light of natural environment and of economic and social consideration.

Sustained yield implies the continuous production and utilisation of some products like wood. Of major importance is the level at which the yield is to be sustained with the ever-increasing population and rising standards of living.

Forestry poses many problems which are attributable, directly or indirectly, to the growing influence of the nations in every country. For example, the increasing demand for pulpwood is relatively more important than that of other timber products. However, the problems in the most parts of the world differ from each other. The main problem everywhere is to provide the population with the bare necessities of life by moving the economy fast enough. Since the World War II a heroic struggle has been done by African, Asian and Latin American Nations to catch up to the standard of living enjoyed by the industrially advanced nations. It is necessary that everyone must enjoy at least the minimum of health, leisure and comforts required to keep one fit physically and mentally. As an ambassador to India, John Kenneth Galbraith¹ stated that the attainment of this goal is "... without question..... the most important and humane task in which men are now engaged".

Forestry is endowed with some peculiar characteristics which altogether distinguish it from other productive activities. Like agriculture, fishing and allied fields, it depends on

¹Gill, R. T. 1963. "Economic Development—past and present." Modern Economic Series Englewood Cliffs, N.J. Prentice—Hall.

products rather than manufacture them. But contrary to these fields, forestry requires a very long period for production. Wood grows only on existing trees belonging to various age groups. Sometimes it even takes one hundred years or more before the consumable goods finally reach the consumer. This means that forest production requires a much large stock of goods in process for a given amount of annual yield than do other forms of production. For example, there should be a plantation of 100 hectares for felling one hectare every year on a rotation of 100 years. Finally forestry produces not just wood but also other products and services such as recreation and water often called joint products. All these characteristics of forestry have economic significance.

Special Features of Forestry

The classical economists thought "land" including forests as a fixed factor of production, but the supply of forests is not restricted. They can be afforested or deforested by man at his will. For instance, under "Static Conservation (Forestry)" fairly good regeneration takes place after felling the old tree growth with a little after-care or "Dynamic Plantation (Forestry)" man-made forests can give rise to a new crop of trees, with the employment of capital, labour and time. Forests as natural resources can be treated as man-made capital. Therefore, they should be counted under capital. An interesting feature of the wood producing factory, i.e. forest, consists of wood having a very long period of final production.

Duerr¹ said that "one characteristic, then of forest capital is that the timber product is also the timber-growing machine, but ultimately the machine is the product. This is more than just an interesting academic point. It is a basic feature of forestry, the consequences of which pervade forest management. A second characteristic of forest capital is "the long period of production in which it is involved".

Nature has bestowed the forest with these special features. The growing stock in a forest is the capital required for producing wood along with other capitals, such as, machines,

¹Duerr, W.A., 1960. "Fundamentals of Forestry Economics" Mc Graw Hill, New York.

nurseries, seed, pesticides, etc. Moreover the introduction of quick-growing species and man-made forests, e.g. "Dynamic Plantation (Forestry)" have shortened the long period in forestry to some extent. The wood is a very versatile product liable to be put to alternative uses.

Forestry and Agriculture

Most countries of the world regard forestry as a part of agriculture first, because (1) a farm produces both agricultural crops and wood, and (2) forests have always played an important role in agriculture. There are references in the Ramayana to the occurrences of severe droughts, and to the worship of the forest-born Sringa, the bringer of rains. Kautilya's political writings of the 4th Century B.C. refer to certain arrangements for the protection of woodlands, to the appointment of officers for supervision of forest operations, and the collection of revenue from produce removed from the forests. "Superintendents of forests" were appointed as early as during the Mauryan Empire (321-185 B.C.) in India. Many people regarded forestry as the "handmaid" of agriculture in some countries because forests provide the agriculturist with ploughs for cultivation, fodder for the cattle and fuel for the hearth. Many countries have treated forestry as a part of agriculture on account of these reasons. Even in U.S.A. and certain parts of Europe the two sectors—forestry and agriculture—have so far been clamped together.

With the application of modern science, however, agriculture has become independent of forestry products to a large extent. In advanced countries, forests no longer serve as main inputs for agriculture, but they supply raw material for the manufacturing industries, viz. pulp for paper, veneer for plywood, and so on. The agriculture and forestry products at stump are produced by two different agencies. Also man does not consume the forest products directly from the stump as he consumes food directly from agriculture. Before he consumes the forest products finally, they undergo certain changes. Forest products are mainly utilised as investment in human resources, e.g. in the construction of buildings, railway carriages, ships, railway sleepers or in making paper

of different types. In an economy, forest and agricultural products play different roles; the former create new investment while the later are finally consumed. Therefore, it is not fair to clamp the two into one—agriculture. Forestry sector is certainly independent of agricultural sector. Hence forestry should be given the status of an ally and ‘foster mother’ of agriculture.

Characteristics of Forest-Based Industries

Special features of forest industries become active when they furnish a very wide range of products, both consumable goods and intermediate goods flowing into many sectors of the economy. The requirements of the industries differ greatly in respect of raw material and other factors. They are characterised by employing alternative technologies successfully. These are based on renewable resources—wood having a close contact with agriculture.

These features suggest that potentially forest industries can play a significant role in promoting economic growth in low-income countries. In this field, there are many industries based on wood, the chief forest product, i.e. (1) pulp and paper, (2) newsprint, (3) plywood, (4) matches, (5) pencils, (6) furniture and cabinet, (7) sports goods, (8) textile auxiliaries, (9) sawmilling, (10) packing cases and (11) firewood and charcoal. In addition, there are some minor industries like wood-wool, wood distillation, tanning, resin and lac. The following industries constitute the main forest-based industries:

- (1) Saw-milling (lumber)
- (2) Pulp and Paper
- (3) Plywood
- (4) Board products

The following table gives a relative idea of world's primary forest industries :—

As is evident, paper and pulp and board products industries yield the highest gross product per unit of raw material. The residue from forest industries and lops and tops from the forest operations help in increasing the gross product per unit of raw material. These have an advantage, the saw-milling industry by contributing more towards value per unit of raw material.

Table 40
Selected Ratios : World's Primary Forest Industries (1960)¹

Forest Industry	Gross value of output per unit of raw material	Investment per person employed	Investment per unit of raw material	Employment per unit of raw material
	\$ per cubic metre	Thousand \$	\$ per cubic (metre) ^r	Number per '000 cubic (metre) ^r
1. Saw-milling	27	2.6	15	5.7
2. Pulp & Paper	57	23.8	151	6.4
3. Plywood	40	4.2	45	10.5
4. Board Products	57	9.3	74	8.0

Investment per unit of raw material and investment per person employed is also the highest in paper and pulp industry, followed by board products, while employment per unit of raw material is the highest in plywood industry.

Westoby divided the world's total production of industrial wood into the following categories :

	Per cent
Saw-milling	65.2
Pulp and paper	29.3
Plywood	4.4
Board products	1.1
Total	100.00

Economically these industries are placed as follows :—

Saw-Milling

This industry is mostly located near forests even though its location is flexible in character. Transport cost of the raw material and finished goods is very high. Manufacture adds little value. Logs used in the mill represent nearly 50 to 70 per cent of the cost of production. Fixed and working capitals sometimes represent fifty per cent as big stock of saw wood is always needed to carry on the industry. It is estimated that nearly 25 to 30 per cent becomes slabs, edgings and saw dust in the saw

¹Westoby, J.C. 1962. "Forest Industries in the attack of Economic Development". *Unasylva*, 16 (4) : 168-201.

mill, to be used as raw material for other forest industries. Since saw-milling does not require a highly skilled labour except a few technicians it appears as if it was started first of all the forest industries in the world. The industry uses both conifers and broad-leaf species.

The saw-milling industry is quite in its infancy in India as it has not received the attention it deserves. Throughout the country, there are no integrated units and if there is any, it does not practise wet sawing. An improved type of sawing used in more developed countries is not practised in India. The following defects occur in dry sawing :—

- (a) When the log lies in the sun, it develops cracks which go deep into the wood and spoil the valuable timber. Thus it gives mostly 50 to 60 per cent of what it could have given had it been sawn in wet.
- (b) Tool wear is excessive if timber is sawn in dry.
- (c) The wood does not cut easily while dry.
- (d) There is danger of fire.

The kurf eats between 15 to 16 per cent while in normal course, it should not take more than 10 per cent. The integrated saw-milling has the advantage of utilizing the waste of one operation for the product of the other. Thus it becomes possible to utilize the wood upto 90 per cent. This industry needs to be reorganized in India and brought up-to-date as integrated saw-milling.

Pulp and Paper

Though this industry requires the largest investment of all the forest-based industries, it has grown so fast that during the last 15 years the world's paper production has doubled. Wood represents 30 to 50 per cent of the total production cost in this industry. Therefore, cheap supply of wood is highly desirable to bring down the cost. Capital, chemicals and power are also very important for running this industry. On account of the important role of these factors this industry needs to be located near the hydro-electric dams which can easily supply the requisite water and power. According to reliable estimates the industry needs a small labour force of which 35 to 40 per cent is skilled. The industry commonly uses coniferous wood, but

recently there has been a shift towards the use of hardwood species in the developed countries. Countries like India do not however use wood to a large extent for the manufacture of pulp and paper. Instead, the following cellulosic raw material are used here.

Table 41
Use of Cellulosic Raw Material for Paper and Pulp in India
(Percentage)

Commodity	III Plan	IV Plan	V Plan 1977 ¹
Bamboo	67.2	66.7	62.0
Salai Grass	7.8	5.8	—
Waste Paper	7.8	3.3	10.0
Straw and other material	2.9	0.8	5.0
Pulpwood (indigenous)	7.4	12.5	17.0
Imported pulp	—	2.5	—
Salai Wood	—	3.8	4.0
Bagasse	6.9	3.3	1.0
Coniferous Wood	—	—	1.0
Rags	—	1.3	—
Total	100.0	100.0	100.0

It is noteworthy that coniferous softwoods were used in 85 to 95 per cent² of the world pulp production while India uses softwood to the tune of one per cent. But now there appears to be a shift from the use of softwood to hardwood. This is seen when we find that the export of hardwoods has increased from 5 million cubic metres in 1953 to 36 million cubic metres in 1969. The use of softwood has gone down from 90 per cent to 75 per cent³ in the recent years. Coniferous wood can be used to a larger extent in India too for pulp production. The bamboo resources of the country are limited and hence they cannot continue to be used up to 62 per cent for a long time. In India the conifers constitute about 5 per cent of the total forest area which is confined to high Himalayan ranges. These forests are usually inaccessible due to their location and lack of means of communications. Even then coniferous wood

¹"Forestry in India 1978", Forestry Division, (Department of Agriculture) Government of India

²Raw Materials for More Paper, issued by F.A.O. Rome Italy, April 1953.

³Gujed For Planning Pulp and Paper Enterprises—F.A.O. Rome, 1973.

constitutes 8 per cent of the total wood production in India. This percentage comprises 26 per cent fuel wood and 74 per cent industrial wood. The Post-Independent era in India saw a steady increase in the consumption of paper and newsprint mainly on account of a general rise in the standard of living of the people and consequent spread of education. But even then the per capita consumption of paper and newsprint in India is one of the lowest among the major paper consuming countries of the world. India imported about 5 per cent of paper and 78 per cent of newsprint of total consumption in 1966-67.

Paper is used chiefly for reading and writing purposes—an investment use. Such demands must be satisfied immediately to increase the per capita income. So far no substitute for paper manufactured from cellulose is known to mankind for writing and printing purposes. Hence, paper holds a position of pride for developmental activities in the world. Thus forests have a great value in so far as they provide the main raw material for paper manufacture, even though in tropical and sub-tropical countries large quantities of agricultural residues can be utilized for manufacturing paper, e.g., India has already started using bagasse for this purpose. The raw material supplied from forests is however, cheaper than that from agricultural residues.

Westoby says that the following features of the forest industries are relevant to development.

1. Import Saving Effect.

The underdeveloped countries consume a small quantity of forest produce, they depending for them mainly on imports. While trying to industrialize themselves, the demand for capital goods increases creating an unfavourable balance of trade. But the development of forest-based industries is likely to minimize the imports of forest products and cause a favourable balance of payment. The underdeveloped countries have a tendency to export raw products, i.e. hardwood logs and import finished goods like pulp and paper. The trade situation in favour of poorer countries can be improved upon by investing properly in plywood and pulp industries. This creates no ground for investing in forestry sector. It may be possible that by invest-

ing in other industries, the produce might give high income elasticity having better import saving effect, the promotion of which is highly desirable. Obviously saw-milling and plywood may be the industries showing the highest effect in the countries exporting raw products—logs.

2. Technological Advantages.

Flexibility in scale and wide range of production seems to be the inherent character of forest industries, as the wood can be produced either in a mechanised way or with the use of unskilled labour, or even both methods can be applied simultaneously. Mechanisation is not fruitful when capital is scarce and labour is cheap and abundant. Villagers in underdeveloped countries have the skill both for timber growing and primitive logging by hand. Agricultural operations are not enough to provide employment throughout the year to the rural population usually immobile and incapable of being employed in any other sector than agriculture or forestry. Wood growing and harvesting in forestry, therefore is the main operation where such resources can be employed.

3. External Economies.

The establishment of main wood using industries gives rise to many subsidiary industries, i.e. saw-dust from saw-mills is used for fuel due to scarcity or difficulty in transporting on account of the bulky nature of fuel wood. This develops the small scale saw-dust stove industry using scrap sheet metal—common feature in India. Chips and other residues from the saw mills can feed a small pulp mill. The forest-based industries are usually located near the forests, resulting in developing new roads and rail links for making use of economies in transporting raw materials. This creates new avenues for other sectors which can use the above means for their benefits for external economies.

4. Estimation of Future Demand.

The estimation of future demands and the supplies is always beneficial for national development. The FAO is helping the underdeveloped nations firstly by sending their experts for assessing the general situation and secondly by preparing detailed plans of work. This organization provides both the

theory and practice of role of forestry in economic development and also the technical forestry education to the less developed countries and advertises and propagates the quick growing species to help the developing nations. Champion¹ has revised the forestry education in tropical countries. As the per capita consumption of wood in the world is likely to increase, the demand for wood will rise, causing the old growth of forests to fall short of the higher demand. Therefore, man-made forests, i.e. "Dynamic Plantation (Forestry)" is the right solution to replace the traditional old forests, i.e. "Static Conservation (Forestry)".

Plywood

The world's production of 3 million cubic metres of plywood in 1939 has multiplied almost six folds during the last 25 years. The availability of large-diameter trees is an essential pre-requisite of plywood production. The finished product is available at 30 to 50 percent and 40 to 60 per cent in respect of ply and veneer respectively due to high losses in conversion. The block-board particle board and also hard board industries are integrated with the plywood industry, as they serve the same consuming sectors, i.e., furniture, construction, etc. Adhesives are the next important raw materials used in the manufacture of plywood. The degree of mechanisation and the size of the logs used in the industry decide the requirement of labour.

India is now almost self-sufficient in respect of plywood. Only 5 per cent of actual requirements is imported for superior packing of high grade tea. She required about 290,000 tonnes of wood in log form in 1971. During 1964 the production of commercial plywood was more than that of tea-chest plywood. This was the turning point in the development of plywood industry in India as up to 1963 tea-chest plywood continued to play a pre-dominant role in the total production of plywood in the country. Tea-chest plywood production in the country is not likely to hold the position of pride for a long time even though

¹Champion, H.C., 1965 "Tropical Forestry Education" Proceedings of the Duke University Tropical Forestry Symposium, April, 21-26, 1965. Bulletin 18, School of Forestry, Duke University, Durham, N.C. pp. 195.

it cannot lose its importance easily because tea is our major foreign exchange earner.

The role of forestry sector in the economic development has not been defined and studied until recently though it was long back recognised as a sector in an economy. Perhaps, first of all the FAO of the United Nations paid proper attention to the role of forestry in economic development. Westoby¹ advocated the idea that public intervention in economic affairs of underdeveloped countries was necessary, and that forestry should find a high place for the National Development. He said that in 1953 the forestry sector and forest products (including both wood products, furniture and paper products) accounted for 7.2 per cent of the total value added and 9.25 per cent of the total world employment of mining and manufacturing industries in terms of value added and fourth in term of employment. This reveals a great difference between the two main branches in labour productivity, which is higher than the average in paper and paper products and much lower than the average in the other branches.

There are two co-efficients on the basis of input-output tables which are able to measure the spread of uses of forest products. The first co-efficient is the ratio of the value of purchased inputs to the total production of a sector indicating how far production in a sector involves the use of capital and labour directly or indirectly. The other ratio involves how much the sector sells its output for further use in production. The underdeveloped countries do not try to convert the forest raw material into other kinds of capital though the techniques are not too complex. Both the production and the consumption of forest products is very high in the developed countries. The underdeveloped countries are even unable to produce to fulfil their requirements. The per capita consumption is very low in underdeveloped countries. It varies from one seven-teenth to one twenty-eighth of the developed world.

¹Westoby, J.C., 1962. "Forest Industries in the Attack on Economic Development" *Unasylyva*, 16 (4): 168-201.

Santa Cruz¹ pointed out in his paper that underdeveloped economies should be institutionalised in respect of forestry for a proper development. This is possible if the government owns the responsibility. He advocates that the forest service in developing economies have the following characteristics :—

1. Planning of its activities.
2. Strategic use of its personnel
3. Undertake socio-economic works.

His contribution is great in respect of exploitation and investment in a planned economy. Chapman² in his paper advocated the importance of forestry in sustaining increasing incomes. Though he could not note the effect of forestry in increasing incomes he said that the demand for forestry products increases if income rises. Therefore the planning of forestry should be done in advance to meet future demands.

The forests of Latin America have been developed with the help of loans mostly controlled by the Agency for Development (AID) in U.S.A. The loans totalled about 5.57 billion dollars from 1958-64. On account of this economists began taking interest in forestry sector there. Gregory³ advocated that the country was endowed with 54 per cent of forest area which was lying uncared for. Here a contrast is noteworthy that Canada, U.S.A. and U.S.S.R. have flourished by tapping their natural resources while contrary to this England and Switzerland have achieved high standard of living in the face of their poor natural resources. The advantages of investing in the forest industries of Latin America are :—

¹Santa Cruz, H., 1966 "The Forestry Sector in Processes of Economic and Social Development and Forestry Institutions". Address at the Third Plenary Session of the Sixth World Forestry Congress, June 1966. The Institutional Framework for Forestry Development F.A.O. p. 11.

²Chapman, G W, 1966. "The role of Forestry Development in National Planning with Particular Reference to the Developing Countries in Mediterranean and the Near East Region": Paper presented at the Sixth World Forestry Congress Madrid, June 1966. No. 6, CEM/E/P 1.2/20 pp 9.

³Gregory, G R., 1965. "Forests and Economic Development in Latin America : A Challenge for the American Forestry Profession. *Journal of Forestry*, 63 (2): 83-8.

1. The Expanding Internal Market

The country imported more than the exports value of the raw material from forests due to low per capita income, thus creating unfavourable balance of trade. A rise in income is likely to create the demand for pulp and paper and thus change the balance of trade into a favourable one. A proper investment in such forest industries may become remedial to this defect.

2. Capital Requirements are Low

Capital costs are relatively lower while wood represents a high proportional cost of the total production in forest industries than many other industries. Therefore, underdeveloped countries with abundance of labour and scarcity of capital can easily set up forest industries.

3. Investment Range is Wide

Forest industries vary from labour intensive saw-milling to capital intensive paper industry meaning thereby that there is a possibility of any kind of investment according to circumstances.

4. Flexibility of Labour

Forest industries can absorb surplus agricultural labour force and increase its mobility by imparting it technical and mechanical training.

5. Economic Linkage

The forest industries have a very strong forward and backward linkage. He supported that fact with statistical data from Italy, Japan and USA. The underdeveloped countries are not likely to have this linkage. Usually the forest industries have strong forward and weak backward linkage, pulp and paper sub-sector being exception.

6. Forests and Land Reform

A few landlords in many Latin American countries control most of the arable land as a result of which the rural population has very small sized holdings. Opening up some forest areas for agriculture can solve this problem.

Investment Criterion

Why does forestry need investment? Like any other economic activity forestry simply cannot be practised without

resources. The scarce resources have alternative uses for satisfying economic wants. Rationalisation of planning means careful consideration of economic policies and practices. The economic criterion which may lead to achieve physical goals, is highly satisfactory. Thus the species which have the highest rate of growth are likely to yield the maximum profit in the long-term. But the mere fact that technical criterion, viz., volume of dry matter production is not enough to imply that decision in respect of management must always be made on the basis of technical factors. Physical aspects do come to play a bigger role when the economic consideration of alternative courses of action is taken into account. There will be a definite variation in costs and prices associated with different courses of action. It becomes clear that economic measures of success are more complex than measures of technical performance alone. The economic measures are not complicated alone but their evaluation is impossible in the absence of full information.

The technical criterion is superior to the economic criterion in forestry as there are two more difficulties with the later. First, the final results of the contribution which the forests make to the forestry sector is not available before the trees are harvested. Secondly it is difficult to predict the values that buyers would like to place on different products, viz. pine or teak logs due to long gestation period involved in forestry. Another difficulty arises out of lack of agreement on proper techniques for assessing the results of alternative courses of action.

Foresters and economists have always had a controversy. Foresters always tried to achieve the highest annual profits regardless of the capital employed and the time taken to build it. All these difficulties associated with economic criterion forced the forest planner to fall back upon the obvious choice of physical measures. The history of forest management shows that foresters have been highly satisfied with the particular silvicultural practices, a system which they prefer. They have never tried to evolve any other criterion.

Allocation of Resources.

The scarce resources are allocated for production of goods and services to satisfy innumerable human wants. If a larger number of wants are to be satisfied then the resources must be used to optimise efficiency. Capital is scarce specially for the developing countries like India, where people are trying to raise the standard of living of the exploding population which need expanded supplies of forest products. Timber is needed for the manufacture of paper for great number of people for the expansion of educational programme, packing cases for industrial products, rail-roads, wagons, factories and for innumerable other purposes.

A current increase in income is not the only criterion of development but future increases also is a criterion. Capital accumulation guarantees future increases. The forestry sector is more or less a capital producing one. Hence it is more important than the cosmetics sector which produces only consumer goods. Accumulation of capital is a time consuming process. It is more likely so in forestry.

Capital is likely to become obsolete if the time taken for its creation is too long. Diverting large sums of resources for the creation of such capital which has a high probability of becoming obsolete before its final products are ready, can be hardly justified from the point of view of economic development. Even if the time consumed is not too long, but since the technological changes occurring in the economy are very rapid, capital will be obsolete before it is produced. The forestry sector has a long gestation period which does not give it preference over other sectors. The importance of the forestry sector diminishes with every advance in technology under other sectors. It is worth mentioning that forestry produces "versatile" capital which gives it an edge over other kinds of capitals.

The forestry sector as a producer of versatile capital, i.e. wood, has a considerable advantage over many other sectors. The forestry sector can claim investment on priority basis if it can produce raw material which is cheaper than the substitutes. The above clarifies that the forestry sector is as important as

the forester can make it for claiming investment from the competing sectors.

Having decided that there is a certain total investment for the economy in any one year, it is to be seen how much of it should be allocated to each sector and how much should be allocated to the forestry sector. Foresters in underdeveloped countries have been arguing in favour of large outlays for the forestry sector. Such arguments generally fail to impress the aggregate economist without the use of proper economic tools for analysis. The government is committed to the goal of economic development if forests are almost controlled by government as is the case in India. The optimisation of revenue to the government for pushing the economy towards take-off stage is the function of forestry in such circumstances. This is possible when the present worth of the forests is maximized by the foresters and the government is ready to invest in these sectors which are a great hurdle to increase productivity. Simultaneous decisions must be taken regarding the optimum amount of forests to be exploited in any one year and optimum amount of "investment funds" to be put into new afforestation programmes or regeneration. There are several methods for allocating funds to different sectors as under:—

Methods Of Choosing Among Alternative Courses

Following are some of the methods which can be employed by an average forester or forest manager who has to decide within the framework of his plan. He can choose relatively among different alternatives.

1. Budget Method

The tabulation of anticipated costs and revenues is done for each alternative in order to select the best after comparing the results. It is suitable for complex problems. In the case of more than one year's revenues and costs, this method is very suitable for reducing them to a single point in time. The cash-method¹ is a special type of budget method where only cash is considered as the main ingredient.

¹Duerr, W.A., 1960. "Fundamentals of Forestry Economics." Mc Graw-Hill, New York, pp, 579.

2. Marginal Method

This method is applicable when there is a wide range, especially a continuous series of alternatives to identify the marginal revenues and costs associated with the series. The alternative which equates with marginal revenue and cost while marginal revenue is falling is the one that shows the greatest excess of revenue over cost.

3. Break-Even Method

This method is used when a certain alternative which may be better than the other at low level but beyond a certain level the other one may be better. This method brings out the break-even point where the two alternatives are equally good. This decision to choose the process may now be taken easily if the level is known at which the work has to be started.

4. Cost Revenue Analysis

This method resembles the benefit-cost analysis approach. The difference lies there that it takes into account only those benefits and costs which are measurable in monetary terms. It might be suitable in case where some few or no intangible factors are involved. This method is suitable when the goal is to optimize the future availability of timber.

5. Pay-Out Period Method

This method is useful when it is aimed at covering the expenses incurred in the shortest possible time or within a specified period. It involves ranking of various alternatives in order to their pay-out periods. The benefit-cost or cost-revenue method can be used to select the best alternative among those which have a pay-out period less than the given maximum.

6. Rate of Return Method

This method calculates the value at which the invested capital grows. The criterion does not take into account the time for which the return is earned. It is therefore, unsuitable for alternative with different life spans. But it is the best method in the circumstances where the earnings are again ploughed back to increase the existing capital. This method suits very well in those circumstances where an underdeveloped country wants to accumulate capital as quickly as possible.

The use of this criterion has been suggested by Spears. It is to be noted that only those projects which have a rate above the current rate of interest can qualify in such a test.

7. Benefit-Cost Analysis and Financial Appraisal

The main function of benefit-cost analysis is to appraise the economic effects of a given project activity in the widest terms. The benefit-cost analysis measures these effects in money terms as far as possible (see Chapter 4 for details). This method was originally developed for use in the field of water resources but can be adopted for any situation in which a choice has to be made between alternative projects. It is especially useful when a number of intangible factors have to be considered (Haley 1966)². This method has been described elaborately by Hirshleifer *et al* (1961)³, Haver *et al.* (1961)⁴, Sewell *et al.* (1961)⁵, and Prest and Turvey (1965)⁶. Though details of the method are not required here but it will not be out of place to say that, while being used at the highest levels of decision making, the ratio of benefits (B) to cost (C) should be maximised so that maximum benefit for each unit of cost is obtained. While being used at a lower level where there is a budget restraint the best way is to maximise the net benefit of (B—C) so that maximum benefit is obtained by using all the resources available for spending.

¹Spears, J.S. 1966. Forest investments from a Government Point of View. Paper presented at the Sixth World Forestry Congress, Madrid June 1966. No 6 CEM/G/PI FAO, pp 12.

²Haley, D., 1966. An Economic Appraisal of Sustained Yield Forest Management for British Columbia. Unpublished Ph.D. thesis, Faculty of Forestry, University of British Columbia, Vancouver, 313 pp.

³Hirshleifer, J.C. Dehaven and J.W. Milliman, 1961. Water Supply: Economics technology and policy. University of Chicago Press, Chicago pp. 378.

⁴Haver, C.B., and Associates, 1961. An economic analysis of Evaluation Practices for Water Resource Development. Mimeographed. United States Study Commission, Texas pp 174.

⁵Sewell, W.R.D., J. Davis, A.D. Scott and D.W. Ross, 1961. Guide to Benefit Cost Analysis. Resources for Tomorrow. Queen's Printer, Ottawa. pp. 49.

⁶Prest, A.R. and R. Turvey 1965. Cost-Benefit Analysis: A Survey. Economic Journal, 75 (300): 683—731.

Propulsive Character of Forestry Sector in Development

The foregoing discussion do not give the forestry sector an upper hand in helping the economic development of a country, but its special characteristics do give it a preference over others. One sector is always correlated with the other in respect of development. The sector playing the most important role in development, can be called propulsive. Manne and Rudra¹ explained that Indian economy can be divided into three groups on the basis of input-output tables. Agriculture and manufacture are two independent sectors. The third sector comprises transport, chemicals and some other services for supplying enough inputs to the former groups. Therefore, this third group can be called propulsive. They keenly noted that such grouping also existed in U.S. economy.

Propulsiveness existing in the forestry sector is not enough to call it a propulsive sector. The best example is the use of wood in capital production. The forestry sector plays permissive role also as the demand for wood may increase due to developmental activities. But these roles cannot be given undue importance in development as forestry contributes very little towards GNP in most countries. According to Central Statistical Organisation, Government of India, this ratio was 0.70 per cent in 1950-51 rising to 1.50 per cent in 1964-65 and 1.2 per cent in 1972-73 while in the case of United States of America, it was 6 per cent (Hair 1963)².

Characteristics of Forestry Sector that have a Propulsive Effect

One of the most important characteristics is that forestry and forest-based industries especially saw-milling absorb the unemployed and under-employed rural human resources, on account of which the social or opportunity cost of expanding such industries is very little. Foresters have never been able to bring out this point before the planners in most of the

¹Manne, A.S. & Rudra, A. 1965. "A consistency Model for India's Fourth Plan" Sankhya, Series B., Vol. 27, Parts 1 & 2 (Sept. 1965) 57-144.

²Hair, D., 1963. The economic importance of timber in the United States, Miscellaneous Publication 941. United State Department of Agriculture, Forest Service, Washington, D.C. 313 pp.

underdeveloped countries. Just to find employment for the under-employed rural human resources is not the only characteristic favourable to the forestry sector but a good organisation on the part of foresters is also essential. The forester especially on account of organisation and management in general is likely to create conditions which do not allow the needs of the forestry and the agriculture for rural human resources to coincide. Though the underdeveloped countries lack management skill but contrary to this, many writers like Reynolds¹, Galbraith², Lewis³, and Beazley⁴, have recognised that India does not lack such skill. In fact India lacks at present, I feel, "Management skill is decision making and getting things done through other people".

The second characteristic of forestry is the versatility of products. Plantations afforested today may be useful as matchwood if they are found uneconomic for veneer or plywood. Even if these are unfit for the manufacture of matches, they can be used for pulping. This process reduces the degree of uncertainty involved in a long-term venture. Some wood may get the highest price and veneer and pulpwood. And yet another might obtain the highest price as pulp and firewood. Due to its long maturity period, the decorative wood gives a very long return when the final value is estimated accurately. Therefore, plantations of quick growing species having short rotation period for pulp, fuelwood plywood or lumber are the very sound proposition in forestry.

The third characteristic of forestry emerges as supplier of cheap raw material for paper manufacture. The developed

¹Reynolds, L.C., 1963. *Economics: Principles, Problems and Policies in Utilizing Land Resources* (first published 1947) Harper, New York, pp. 599.

²Lewis, J.P. 1964. *Quiet Crisis in India* (first published 1962), Doubleday Garden City, N.Y. pp. 383.

³Beazley, R. 1965. *Planning and the Development Requirements in Forest Land Sector or Less Developed Countries*. *Proceedings, Society of American Foresters*, 1965. Detroit, Mic: 79-91

⁴Galbraith, J.K. 1964. *Economic Development* (first published 1962) Houghton-Mifflin, Boston. pp. 109.

countries of the world frequently use the conifers for pulp manufacture. But paper is capital in underdeveloped countries. Forests, therefore, become as asset for manufacturing paper. The cultivation of bamboo—a very good source of cellulose—is a kind of forestry different from traditional forestry. Residues from agriculture are likely to become tough rival raw materials to forests. Though paper is capital no one can force its manufacture from forest produce. It can also be produced from cellulosic contents of jute sticks, cotton linters or bagasse from sugarcane. In spite of all these arguments, the forests in many countries of the world are likely to hold a position of pride for the supply of the cheapest raw materials for the manufacture of pulp.

The fourth characteristic of forestry sector is its utility as a foreign exchange earner and import substitute in underdeveloped countries. The imports of wood and wood products in India were to the tune of Rs. 181 million in 1959-60 which rose to Rs. 241 million in 1970-71. This import has an increasing trend. Though the amount of this import is relatively small in relation to the economy as a whole, this argument does not hold good. At any rate, this must be saved if it is possible by investing some smaller funds. There can be a saving in foreign exchange if India starts producing viscose pulp for the manufacture of celluloid film as she commands the second position in the world in respect of movie production. She spends a colossal amount of foreign exchange on the imports of raw film. Forest raw material and benefit-cost analysis may prove useful for this purpose. India has started exporting furniture to some extent. It could be stepped up if wood is properly seasoned.

The fifth characteristic of forestry is that it can supply cheap fuel to the agriculturists to save their cowdung for valuable compost to increasing the productivity in agriculture which fact has a great significance for economic development. The underdeveloped rural resources can be utilised for raising cheap plantations of quick growing species. If this is not possible, the farmer will continue burning the cowdung. In such a case he should be supplied with cheap chemical fertilizers.

The sixth characteristic of forestry is that it is very important for regional development especially in underdeveloped countries. It is essential to study the role of forestry for those economies which have a regional developmental goal in view as a part of their national economic development policy. Canada is interested in such studies. Those regions which abound accessible forest resources are likely to help local capital formation. Once the role of forests is recognised as national forest capital in one region, it can help create other kinds of capitals. The national role of all resources is important for underdeveloped countries as a whole, but following such policy will become difficult on account of regional differences and political considerations.

Forest Management and Planning

Forest Management

The Society of American Foresters (1958)¹ defines forest management as "the application of business methods and principles of technical forestry to the operation of a forest property." This definition is of a manifold nature. According to Roth (1925)² the task of forest management is to build up, put in order, and keep in order a forest business. Management of forestry resources tries to achieve the fuller knowledge of all the branches of forestry through integration of forest business.

Forest management is the life and blood of the art of forestry. The forest manager is concerned with everything that affects the operational area in his charge. He is supposed to have an intimate knowledge of silvicultural rules, the long-range viewpoint of the planner, the skills of the administrator, and all that goes with a successful businessman.

The forest management is concerned mainly with the following :—

Forest Management

I. Business and Social Aspects

- (1) Accounting
- (2) Business law
- (3) Economics
- (4) Finance
- (5) Labour relations
- (6) Marketing
- (7) Organization and administration
- (8) Real estate

¹American Forestry Association, 1951. The Progress of Forestry, 1945 to 1950. Washington, D.C.

²Roth, Filibert, 1925. Forest Regulation, 2nd ed., George Wahr Publishing Co., Ann Arbor, Mich.

(9) Social and Political Science

(10) Statistics

II. Technological Aspects

(1) Civil Engineering

(2) Entomology

(3) Fire Control

(4) Grazing

(5) Logging and Milling

(6) Mensuration

(7) Pathology

(8) Recreation

(9) Silviculture

(10) Water

(11) Wildlife

(12) Wood Technology.

Forest management has to consider all these aspects. It is impossible for an individual to master all the branches of knowledge. Though the forest management has a wide field, its scope is limited when treated as a specific subject. The forests are managed with the purpose of timber, wildlife, recreation and watershed. Its definition includes three main, interlinked functions, namely settlement of the purposes and main policy to be pursued, the consequent planning and organization of activities and the conduct of operations.

Policy

Policy issues are decided keeping in view the purposes of the owners in relation to the resources available and the future prospects. The assessment of purposes will clearly demand an understanding of several factors, namely :—

(i) The physical resources created with the help of land, labour and capital, and their influence on the proposed functions.

(ii) The technical functions

(iii) Demand potential on the forest products

(iv) The human resources

Of the above factors any may be unstable. Therefore, either policy, or definitions of purposes or the location might be prone to change and thus they need a constant review. The

purpose must clearly be redefined with an order of priorities. Confusion of purpose disturbs action.

The function of this branch of management is to decide how best the forest resources be utilised to attain its purpose and policy. Planning of forest resources may involve the following functions :—

Political, social and economic forces play an important role in deciding the amount and the kind of forest that a country should have at its disposal, Forest planning begins with the recognition of what the country needs from its forests. The following are the main needs of a country, viz. (a) wood production, (b) amenity and recreation, (c) nature conservation, (d) provision of employment and (e) protection.

The species which should be grown, the type of land that should be used and the methods of management that should be applied to the forests so as to meet the requirements of the nation are some of the technical matters to be decided. They are to be determined in the light of needs of the nation mentioned above. While deciding about all these factors, the soils and climatic conditions of the country, the intensity of competition from other land uses and the possibility of providing forestry benefits by other means including imports of forest products from abroad should be kept in view.

Planning and organization

This branch of management decides as to how the forest resources of the country should best be used to attain its purpose and policy. The following five points are worth consideration in respect of planning

(i) Provision and lay-out of the productive machinery which is needed to produce the desired products— either material goods or services. This will become the basic capital of the forest department, viz., machines, buildings and plants which are arranged in the most productive manner.

(ii) Arrangements for supply of raw materials best suited to feed the productive machinery.

(iii) Arrangements for supply of finished products of the forest department to consumers.

(iv) The human resource should be planned to assign duties and fix responsibilities for conducting the forest department as a whole.

(v) Finance.

The Management of Forests

The simple principles of management govern the forest management also. However, it is true, that forestry is endowed with certain peculiarities which distinguish it from other forms of industry, other sources of raw material and even other uses of land. A brief examination of distinctive features of forestry that affect forest management, is necessary.

Five main characteristics are inherent in forestry, namely:

- (1) A long gestation period is required to produce its products,
- (2) the timber product is also the timber growing machine which ultimately becomes product,
- (3) the timber grows very slowly, thereby showing a modest rate of return,
- (4) the variable costs include a major part of growing costs of timber,
- (5) the timber is versatile.

The Time Factor

The most outstanding feature of forestry capital is that forestry products take very long to mature. The management over such long periods, can be hazardous indeed in a dynamic world. The risk—the chance of loss—can be high as no one can clearly foresee the distant future. A treeless area which is either planted or sown must be set aside for nearly more than a century for the development of a single stand. The capital—the costs of establishment and the value of the soil—is thus invested on a long term basis. It cannot be liquidated without incurring losses—assuming, of course, that the long rotation has been correctly chosen from an economic point of view. The interest on the invested capital accumulates during the period of the stand's development to a very large sum.

If, however, a forest is grown to provide a service—recreation or protection against wind, for example—there is still a time-lag between the creation of the forest and full realization of its benefits. Services begin flowing into the economy once the forests are grown satisfactorily to an adequate age. The time factor, therefore, does not influence to a greater ex-

tent in those forests which are grown to provide a service rather than in those for material goods.

The growth of different species of trees and even the same species on different sites vary to a large extent. Moreover there is a possibility that trees at various stages of growth are liable to provide different usable products viz., fencing poles in youth, constructional timber, veneers, at mature age. Here the forest manager faces some problems as to how he should combine the management of trees which are growing at different rates in one and the same forest and what criterion should be adopted to choose between different types of product.

There are two basic interrelated problems. First, the original decision taken on what to grow might have to be changed because of the changes in market conditions during the period of production. For example, until 100 years ago oak was abundantly grown in England mainly both for naval purposes and also for construction timber. It is not valued now as those purposes for which it was grown, are no longer in existence in England. Thus 100 years or more spent in growing such trees are more or less wasted. Another example can be cited of coppice wood in Europe. This type of wood becomes worthless owing to availability of substitutes for fuel-wood, fencing material. Growing of another species in the forests becomes expensive and slow after a change over. It is a challenging job to decide about growing of tree species. Forecasts of demand, which needs a constant review, requires a careful consideration.

Second, the returns are delayed from the initial investment owing to long gestation period involved in forest products. The capital is tied to ground. This delay requires special consideration for investing into forest enterprise.

Timber Product is also a Timber Growing Machine

The forests produce raw material, wood, the stem and the branches of trees in thin layers annually. The circumferential growth then depends on the absorption of water and nutrients from the soil, of oxygen from the air and on photosynthesis by the leaves which use carbon dioxide contained in the air and energy from heat and light. Thus it is clear that the trees are

the machinery to manufacture the desired products. This machinery is driven with the help of raw materials, viz. water, soil nutrients and solar energy.

Forests perpetually produce raw material—wood. Unlike the exhaustible minerals, the forest raw material can be inexhaustible. The capital, viz. the stock of trees is both manufacturing and consumable produce which increases at compound rate of interest.

Thus the product as well as the capital are harvested side by side. Two problems arise when the whole tree is harvested for use as raw material. Firstly, the quantity of trees cut must be related to increment of trees as a whole so that the remaining trees may be sufficient to supply the capital (machinery) considered necessary for proper growth of capital. Secondly, the tree must be suitable to the consumers' taste. The trees must be located in such situation that their harvesting may be easy and promote the health of the remaining stock in the forests.

Timber grows very slowly and thus shows a modest rate of return

This characteristic of forest capital follows in part from its long period of production. This is known as modest rate of return. Although the thesis of commercial forestry rests on the central issue of rate of return, we have little data on this vital issue. What we have learnt from permanent experimental management units and other managed area, is that the highest rates are produced in Kerala. The softwoods in India generally yield lower rates of return.

Timber growing costs dominate in the variable costs

This characteristic of forest capital shows that timber growing costs dominate the scene in variable costs. The forest manager may exercise some control over these costs during the period of production.

As an extreme case, suppose the forest is left untended until harvest. The Forest Department does not make any special efforts towards forest protection etc. In such a case the cost of holding the forest capital or timber growing stock, may represent nearly 100 per cent of all variable costs. At the opposite extreme, where the Forest Department has to parti-

cipate actively in all silvicultural programmes. the cost of the timber capital still may overshadow that of other capital and labour.

Timber is Versatile

This characteristic of forest capital is its versatility. Some kinds of capital are highly versatile in the sense that they can be shifted readily into any of a variety of uses. Money is the extreme example. Raw materials such as iron and petrol are other examples. Some kinds of machines too are versatile: electric motors, for instance. Versatile capital is an advantageous investment. It is because the capital may be shifted to other uses where prospects may be brighter in case the prospective rate of return declines in the capital's current use. If capital cannot readily be shifted its value may fall heavily if prospective demand for its product declines. Of course, if prospects brighten and other capital cannot readily flow into this line of production, the value of the capital already there may rise greatly for a while, and its owners may reap corresponding rewards.

Forest capital is fairly versatile. It can be used for many purposes. Often it being alternatively machine and product, it is more readily convertible into money than most machines. Furthermore, it has rather high "time versatility" viz. owing to its durability, it can be shifted either now or later on.

Forest products are used to satisfy many human requirements which vary greatly from tangible raw materials to intangible benefits. The raw materials are of different forms—from poles to veneer logs, pulp wood to gums or medicinal herbs while the intangible benefits vary from aesthetic enjoyment to protection from storms. Thus it is seen that in both the cases, viz. aesthetic enjoyment and protection from storm almost no tree felling is required. This action prevents no economic production of timber or produce greatly. However, it is possible to segregate production of each main product in different areas. In such a case the management of forests is greatly facilitated.

A great number of people can enjoy them aesthetically, in recreation or in a scientific study. They produce raw mater-

ials on which many industries depend. These industries provide employment to a large segment of population. Moreover they protect people and land against wind, erosion or storms and regulate the water supply for humanity. All the above services make some forests essential. Such forests cost much to the exchequer for maintaining them. However intangible products often mix with tangible ones in one and the same forest. Therefore, the management of some forests in terms of money becomes difficult to be justified. It is still tedious to decide in the case of public forests where it is not easy to divide them in multiple beneficiaries. The management of forests cannot be justified as long as they do not disappear to prove their past value.

Purposes of Management

Forest lands are often managed for a multiplicity of purposes. Timber production is the dominant use on a particular area. Forest lands can often be managed for several uses assigned to separate area and sometimes with different dominant uses assigned to separate areas. Management is meant to achieve the highest total net benefit. A forest managed for timber production can also serve watershed, wildlife or recreational purposes. In some cases land uses are incompatible, one with another. Grazing seems to be unfitting with timber production or recreational use. Recreation is sometimes a highly dominating use on account of which all timber felling, grazing and hunting are banned. However, this situation has not come in Indian forestry so far. Forest land management mostly covers watershed management to ensure that forest and other vegetative cover serve to protect and maintain water supplies to the fullest extent possible.

The first basic feature of forest management is that forestry like agriculture is a primary use of the land surface. Therefore, the forest management is meant to find out the factors which influence the growth of vegetation particularly the tree growth. These factors are rather complex since they involve botany and physiology of plants and their ecology, geology and pedology and the effects of soils and climate on growth. The forester can grow the highest amount of produce with such an understanding.

The forester is not only responsible for getting a satisfactory growth of vegetation, viz. trees, but he has a greater responsibility of harvesting and selling as well as replacing them with new seedling trees. However, tending, harvesting and replacing of trees require roads and other communications, buildings, mechanical equipments etc.

Therefore, there is wide range of technical factors in forestry from botanic taxonomy, anatomy and physiology to engineering, from land and vegetational survey to soil science. It includes mensuration of quantities and growth of trees to sociology.

Since forestry involves a wide range of skills which are out-lined on the page 275, no one person can be expected expert in that array of skills. The forest officer is supposed to use and coordinate action for the best results.

In the same way no single book on forest management including all the subject matter relevant to forest management as a whole can be a successful volume. Therefore, this book is intended to deal with the principles of planning and organization of continuous forest operations, viz. the technical foundation of forest management. It will also deal with planning decisions excluding administration meant for improving or maintaining efficiency in the execution of a plan.

Since detailed study in silviculture has been made by Troup (1952)¹, for our purpose a considerable reference to the need to have a dynamic silviculture both flexible and practical, will be made as well as the management organization necessary in the practice of typical silvicultural methods:—

Briefly the scope of the forest management can be classified into three main groups as follows:—

1. Control of growing stock, its composition and structure

- (i) Choice of species
- (ii) Site adaptation
- (iii) Harvesting
- (iv) Regeneration
- (v) Protection

¹Troup R S. 1952. Silvicultural system, 2nd Edition, edited by E.W. Jones. The Clarendon Press, Oxford.

2. Sales and distribution of products (communications, logging and sales)
3. Operational efficiency (administration of property, organization and control of personnel and work, records and finance).

The main peculiarities of forest management relates to growing stock.

Management of forests depends on control of the growing stock. The primary problems in afforestation projects are site preparation and choice of species. The chief activity in forestry is the handling of the growing stock. It is mainly felling the trees and collecting the produce. At the same time the forester has to mould the forest stands into the forms volumes and ages which suits him. Clear felling of trees as also by regenerating the existing species are the means to change the species. We can protect the growing stock by choosing as to "when where and what" types of trees should be felled—for example the arrangement of shelter against wind or sun.

Four interlinked problems exist in forest management. These need perpetual decisions in respect of growing stock.

(i) How many trees to fell to provide the desired protection to tree growth of age and size. It is just to locate the relation between cut and increment of the forest.

(ii) Felling should be carried out at a fixed time to promote the growth of trees left behind and also to collect the final harvest.

(iii) It is necessary to decide about (i) and (ii) by allocating the area to facilitate logging, needs of protection and design the forest structure subsequently.

(iv) It is necessary to know how to cut to achieve the intensity of felling to promote the desired growth of trees or to encourage regeneration.

It is obvious that an intimate knowhow of what the forest consists of should be had before it is decided as to how the forest should be treated in respect of growing stock. The forester should know the volumes of timber which exist in the forest and their distribution among stands having different ages or sizes of trees, viz. he should know the matured proportion

to the unmatured tree growth in the forest. He should also know the rate at which the trees are growing or will grow after treatment. At the same time he should also know what other species could create better results in the available sites. Another fact is to know how the fertility of those sites can be improved upon.

Therefore, the planning of forests depends on full knowledge of sites and growing stock. Since knowledge is always incomplete and circumstances ever change, the planning may have unforeseen unstable results. Therefore, continuous assessments of the situation are essential which does not need only to gather new knowledge but also to link results with treatment on account of which the experience might be able to improve planning exercise.

Therefore, it is seen that the forest manager is not independent of the sciences of mensuration of trees and wood, of ecology, pedology, and economics etc.

Forest management as a business

The status of forest management can be comprehended if it is recognised as a business, viz. a segment of the total business community. This might be true in respect of those countries which have commercial forests in private hands particularly viz. U.S A. where the owners have a tendency to compete in the economy. This is not applicable to Indian conditions. Many of the same forces apply to the management of publicly owned lands; raw materials from those lands must be sold and processed and the final products distributed to the same markets. Such considerations do apply to other than timber forest uses too. General economy requires recreation, wildlife, water etc. People, however, think that forestry affairs are somewhat different from others in the economy. Though some times they differ but the large area of similarity makes them analogous. It is seen that there is much in common among certain business groups, though all business in a given area is not being conducted under the similar conditions. Central and state income and other tax laws affect every one alike. The same is true of social and industrial legislation. The same general financial system serve all business. On the other hand

they have more or less access to investment opportunities and financing services. General markets deal in equipment and supplies for the most part while the forest products are manufactured, distributed and sold in competition with many others. Forest businessman too has the same attitude towards problems, public controls, and such things as do other businessmen. They belong to the same fraternal groups. Therefore, the same general forces which encourage large or small business also affect forestry which is both large and small business. In the same way general depression or prosperity affect forestry business. Essentially, all business need good administration.

Some qualities are peculiar to or attach greater importance to forestry problems. One of them is the length of time needed for production in forestry sector. The production of a stand takes decades, or even a century for the maturity. Another is the identification of the "machine" (the tree) with the marketable product. For example, a shoe manufacturing factory cannot be used in parts to make more shoes while it is true of forestry. There are no water-tight compartments where growing stock demarcated into marketable inventory and the product that should currently be harvested, can be kept. The ratio between marketable inventory and products currently felled is very high, often 10 or more to 1. There is, thus, regular temptation to fell down trees which should be left standing for growing stock. Raw material supply and inventory control are critical problems in forestry and therefore, peculiar to it. Other businesses too confront supply and inventory problems. Though cyclic variations in demand for forest products are often wide, it has no peculiarity to the timber business.

Forest production involves extremely high capital costs. It is estimated that 25,000 acre plot of well-stocked productive land in the charge of a forester can represent capital value between 5 to 6 million rupees including land, growing stock etc. Taking into account all permanent personnel and including overhead charges, the investment per employee runs into high magnitude of several hundred thousand rupees. Commercial forestry is so expensive in per capita investment that very few other industrial groups can compare with it.

Character of management practice

It is difficult to determine the character of management practice since many things are involved in it. Of these many are impossible to measure quantitatively. Intent ownership is often an intangible thing. However, it is more important in determining whether a given area is well managed. Economic setting is another important thing to judge management. It is a relative rather than an absolute matter. Applied management comes into action when management plans provide sustained yields.

Forest affects management

The forests themselves set the general pattern of management to a considerable extent. In this respect one approach is to appraise the character and condition of the forests of the country along the nature of the problems they offer.

The forests in India face a major problem that no inventory in a right way has been prepared so far. In the Himalayan ranges, it becomes very difficult to exploit the matured trees owing to lack of communications there. The growing stock in the forests is not known correctly. The gross annual increment of growth in forestry is 33.7¹ million cubic metres. However, it is believed that the increment is not less than 60 to 70 million cubic metres¹. Since no systematic survey of forest resources has been conducted so far, these figures are any body's guess. The computation of increment in different forest areas specially by main species and its correlation with the annual cut are regarded as the basis for a proper forest management. Today India lacks this information.

Very little was known about the volume of different types of species available in Indian forests until the Pre-investment Survey of Forest Resources² was initiated by the Government of India, the Food and Agriculture Organization and the Development Programme of the United Nations in 1965. Using modern appraisal techniques, the survey gave detailed

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1. Report of the Task Force on Forest Resources Survey, Planning Commission, 1972.
 2. FOR/SF/ND 23-Terminal Report on Pre-Investment Survey of Forest Resources: FAO.

information about three separate zones located in Northern, Central and Southern India. According to the survey, greatly increased cuts of saw-logs including teak and sal wood would be available from the central zone. The Northern zone can supply moderate quantity of coniferous sawlogs annually. The growing stock is estimated at 110 million cubic metres in the southern zone. It also contains an estimated quantity of 1.2 million tonnes (air dry) of bamboos and five million tonnes (air dry) of reeds. Thus the quantities of wood available for commercial use are considerably higher than those which have been believed hitherto in forestry circles or the Government of India.

Present Management

The system of management applied to various forest types is briefly discussed below. An account of the vegetation of the various types of forests has already been given earlier under Chapter 1.

Group 1. Tropical Wet Evergreen Forests:

These forests are divided into two viz. (A) Southern tropical wet evergreen forests and (B) Northern tropical wet evergreen forests. It is noted here that the type A extends to Andamans and the western coastal region of India. These forests are characterised to have many species in them but only a few of them can find an economic use in the economy. Therefore these forests are worked under the selection system where a minimum exploitable girth is fixed. This varies with the species but in some cases it is prescribed at 2.1 metres. The fellings are followed by artificial planting in gaps. However, the non-tidal forests of Andamans are worked under a system of conversion to uniform with concentrated natural regeneration.

The Northern tropical semi-evergreen forests:—Assam is usually the home of such forests which are worked under the Indian regular shelterwood system with a floating periodic block. These forests are mostly worked under natural regeneration however valuable species are planted in the regeneration block.

Group 2. Tropical Semi-evergreen Forests:

This type is localised in some parts of Andaman, Assam, Orissa, Kerala, Karnataka and Tamil Nadu. The species of timber value are Dipterocarp, Shorea, Mesua and Palaquium which are found there. These forests are worked under the selection system with different exploitable diameters for different species. The exploitable girth is about 2.1 metres with felling cycle of 20 to 30 years.

Group 3. *Tropical Moist Deciduous Forests:*

This type of forest consists of two of the most important timber species of India viz.;

A. Teak (*Tectona grandis*); B. Sal (*Shorea robusta*): These are the most commonly distributed timber species of India.

3 A. Teak: (*Tectona grandis*); Teak is the most valuable timber of India. It occurs mainly in Gujarat, Kerala, Tamil Nadu, Andhra Pradesh, Madhya Pradesh, Maharashtra and Karnataka. These forests are worked under the following systems:—

3 A (i) *Improvement and Selection cum-Improvement Felling System:*

There are a limited number of forests which are worked under this system. The system is in vogue only in the hilly regions and mixed forest with very small percentage of teak. 60 cm is diameter fixed for exploitation and felling cycle is 20 years with 50 per cent limit on removal of selection trees. Artificial regeneration is also followed after felling of selection trees in Gujarat.

3 A (ii) *Conversion to Uniform System:*

The major part of the moist teak forest is worked under this system. The conversion period varies from 80 to 120 years. Such forests are divided into 4 to 6 periodic blocks of 20 to 30 years. Advance growth is also clearfelled in those areas where there is no danger of frost. However the advance growth is retained as part of the future crop in those parts where there is danger of frost. Artificial regeneration is applied to supplement natural regeneration since there is no perfection in this method so far.

TECTONA GRANDIS

Plantation Site Qualities

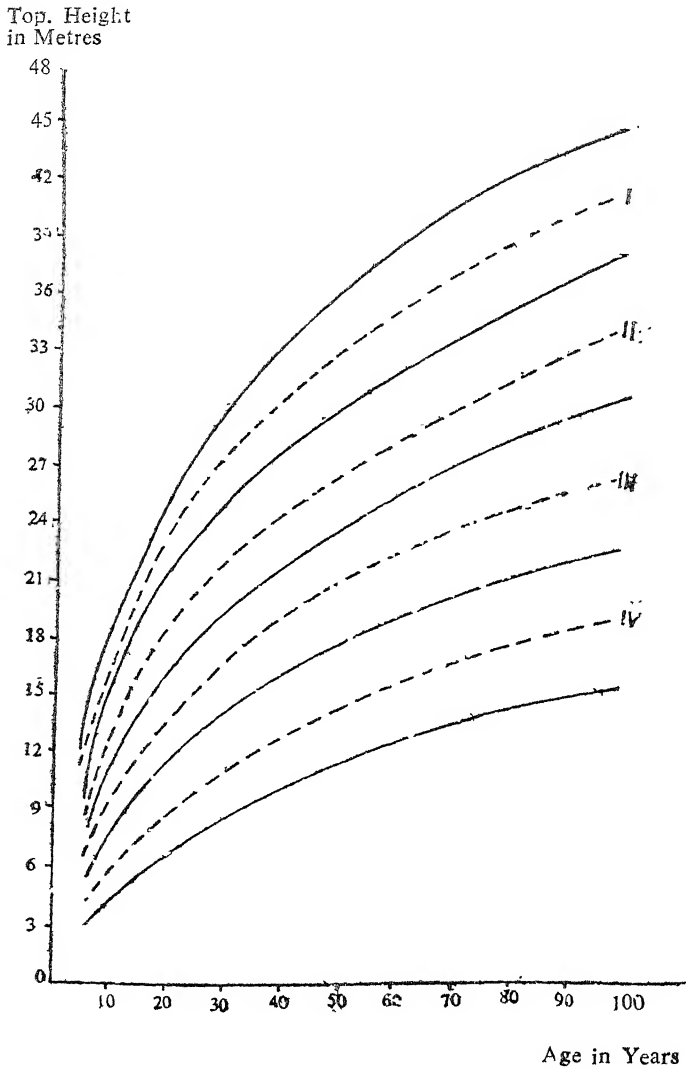


Fig 16

3 A (iii) Clearfelling and Planting:

Teak is mostly worked under this system as it provides certainty and speed to cover large areas under plantation.

These are worked under a shorter rotation of 50 to 80 years. Stump planting is applied (root and shoot cuttings having about 3 cm of shoot and 20 to 25 cm of root prepared from one year old nursery raised seedlings) is applied. Teak is usually raised in pure plantations but in some parts mixtures are not ruled out.

3 B Sal (*Shorea robusta*):

These forests extend from western Uttar Pradesh to Assam and from the foot-hills of the Himalaya to lower parts of central India. Sal forests are usually worked under every silvicultural system which is prevalent in the country. Selection system is applied to the sal forests in the hills. The rotation period varies from 120 to 180 years with an exploitable diameter from 45 cm to 60 cm. The percentage of trees to be felled is fixed after keeping allowance for mortality. This is worked by Sagreiya's modification of Brandis method in M.P. and by Smythies safeguarding formula in Uttar Pradesh. The fixing of yield is done either in terms of trees of exploitable diameter or as a percentage thereof. Where there is practically no regeneration, only improvement operations are prescribed consisting of removing the dead or dying trees only at regular intervals which is usually 10 to 20 years.

3 B (i) *Conversion to Uniform System*:

Sal of better quality situated in Assam, Bihar, Madhya Pradesh and Uttar Pradesh is worked under this system. Attempt is being made to sort out areas having trees of same age gradations. The conversion period varies from 120 years in Bihar to 150 years in Assam. The periodic blocks range from 4 to 6. This system has failed everywhere except in Bihar and part of Assam. Therefore, it has been gradually replaced with the Indian shelterwood system. No attempt is made to achieve uniformity of crop under this system. The fellings are done to free the advance growth. The forests are divided into various periodic blocks at each revision of working plans which depends on the stage of the advance growth present there. Therefore, the fellings must follow regeneration. Under periodic block I, even trees upto 40 cm in diameter are retained because these are treated as part of the future crop during felling.

SHOREA ROBUSTA

High Forest Site Qualities

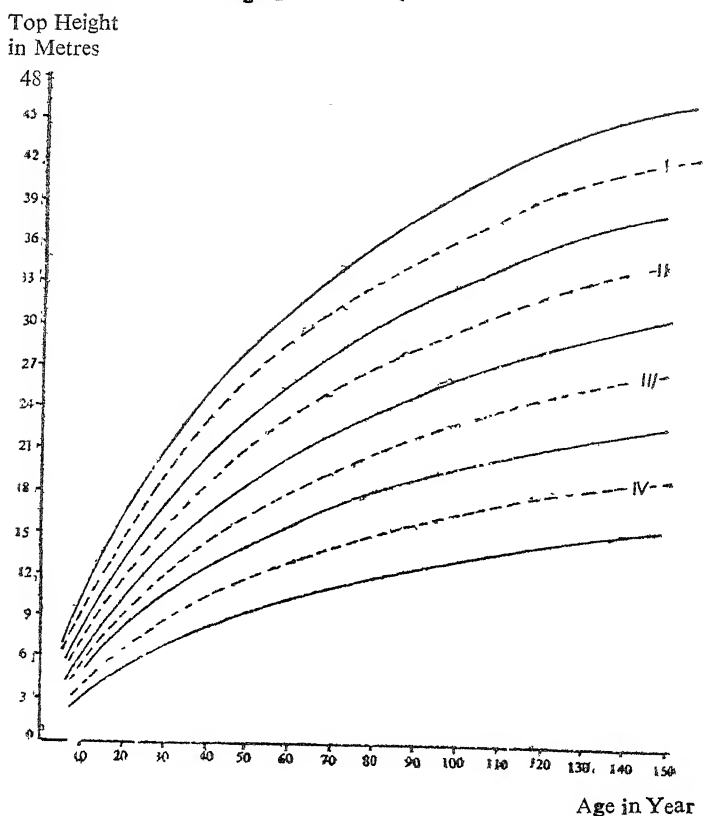


Fig 17

3. B (ii) Coppice System:

Either of the two systems, viz. (i) simple coppice or (ii) coppice-with-standards is followed when there is heavy demand for small size timber, poles and firewood for local population or for some industrial use. This system allows all trees to be felled in the area with a view to obtaining regeneration by coppice. Some trees are spared either to provide shelter to the coppice shoots against frost or to meet demand of large size timber.

Standards is the name given to these trees. The rotation for coppice ranges from 30 to 40 years and for standards it is

60 to 90 years. The system is in use extensively in parts of Uttar Pradesh and Madhya Pradesh. A modified system known as Coppice-with-Reserves is followed in Madhya Pradesh where sound advanced growth of all economically valuable species is retained as a part of the future crop.

3 B (iii). *Clearfelling and Planting:*

In parts of Uttar Pradesh and Bengal where there is no danger of frost and where labour is easily available sal forests are worked under this system. When plantations are raised in conjunction with forest crops it is called *taungya* which resembles the agri-silviculture.

3 C. *Mixed Forest without Sal and Teak:*

These forests are mainly worked under the (1) selection-cum-improvement and (2) clearfelling systems. Smythies safeguarding formula is applied for fixing the percentage of trees in the former. Different selection diameters are fixed for the important species. Clearfelling is being resorted to in recent years. Planting of these forests by preparing the ground by mechanised means is done in Uttar Pradesh along with some agricultural crop. This is practised to keep down grasses and also to increase food production.

3 D. *Bamboo Forests:*

Bamboos occur in admixture with other miscellaneous species. They are worked under a cutting cycle of 3 to 4 years. The immature culms are retained along with an adequate number of mature culms. *Dendrocalamus strictus* is the most widely distributed bamboo which occurs in the country. *Bambusa arundinacea*, *Melocanna bambusoides*, *Bambusa tulda* and *Dendrocalamus hamiltonii* occur in the country arranged according to their importance. The species and locality factors decide their yield potential.

Group 4. *Littoral and Swamp Forests :*

Mangrove species viz. *Heritiera*, *Avicennia*, *Rhizophora*, etc. occur in this type of forest. The species occurring in this small type of forest are worked under selection-cum-improvement system or coppice system.

Group 5. *Dry Tropical Forests :*

This group of forest, comprise teak, sal and miscellaneous species which find their place in Andhra Pradesh, Bihar,

Gujarat, Madhya Pradesh, Maharashtra, Punjab, Rajasthan and Uttar Pradesh. Simple coppice or coppice-with-standards or coppice-with-reserve are the most prevalent systems to work these forests. The rotation of coppice ranges from 30 to 40 years and that of standards from 60 to 90 years. Selection-cum-improvement system is also used to work some forests specially in Andhra Pradesh, Uttar Pradesh and Orissa. Clear-felling and planting system is also applied to a small percentage of forests where there is small number of valuable species.

Group 6. *Tropical Thorn Forest* :

6 A. *Mixed Forest* :

These forests are found in parts of Andhra Pradesh, Gujarat, Madhya Pradesh, Maharashtra, Punjab, Uttar Pradesh and Rajasthan. Selection system, the coppice system and clearfelling and planting systems applies to the working of these forests, depending upon the locality.

6 B. *Sandal Forest (Santalum album)*:

Karnataka and Tamil Nadu are the homelands for these forests. Only dead or dry trees are allowed to be extracted under 3 to 6 years felling cycle on account of spike disease which causes high mortality.

Group 7. *Tropical Dry Evergreen Forest* :

The extent of these forests is comparatively very small.

Group 8. *Sub-tropical Broad-leaved Hill Forest* :

This group comprises miscellaneous forests with and without sal, and teak. These forests are worked under selection-cum-improvement system.

Group 9. *Sub-tropical Pine Forest* :

Two important pine species (1) *Pinus roxburghii* and (2) *Pinus khasya (P. insularis)* comprise this group in India. The former occurs in Uttar Pradesh and Jammu & Kashmir while the latter in Assam. These species are worked under the uniform system with floating periodic block but the very precipitous slopes where no felling is permitted. The rotation is kept at 120 years, with four periodic blocks. This system is quite successful to create natural regeneration.

Group 10. *Sub-tropical Dry Evergreen Forests* :

The extent, of such forests is very small.

Group 11. *Montane West Temperate Forest :*

These forests are found in the southern and eastern Naga Hills. Their extent is small. These forests are clearfelled and artificial regeneration is resorted to with oaks and other species of economic importance in north Bengal. The rotation depends upon the species regenerated.

PINUS ROXBURGHII

Site Qualities

Top Height
in metres

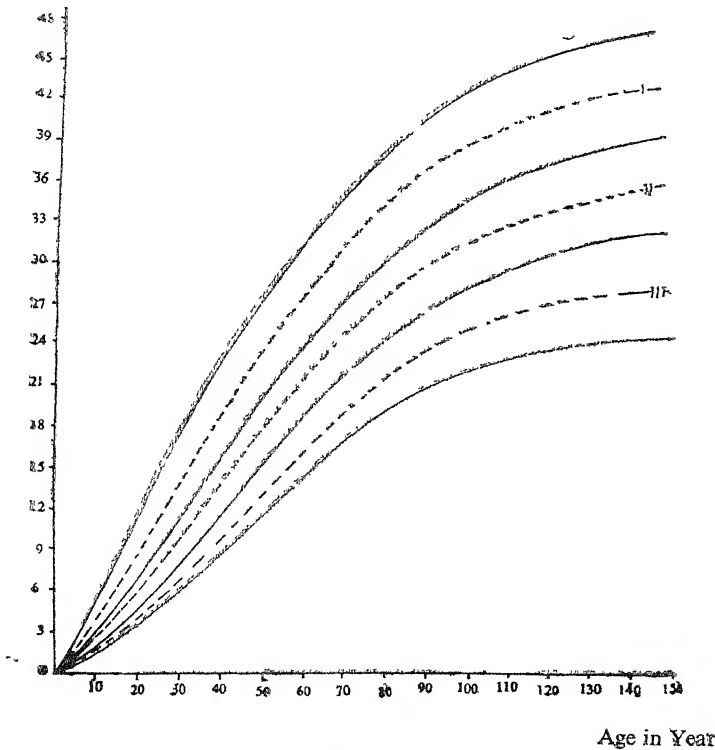


Fig. 18

Group 12. *Himalayan Moist Temperate Forests :*

This group comprise some important forests of fir, spruce, deodar, kail and various oak forests. These are worked under various systems depending on species.

12 A. *Oak Forests :*

These forests are worked under selection-cum-improvement and coppice system. Generally the wood is used for firewood and charcoal and the leaves are often lopped for making fodder for cattle. The forests situated near the habitation are worked while the rest are treated as protected.

12 B. *Fir and Spruce Forests :*

Both these species *Abies pindrow* and *Picea smythiana* are found mixed. These are worked under selection system in Uttar Pradesh, Jammu & Kashmir with selection diameter of 60 cm while in Himachal Pradesh these are worked under the Indian irregular shelterwood system with a rotation of 160 years with six periodic blocks. However, some of these forests are still inaccessible. Felling is impossible there owing to lack of transportation facilities.

12 C. *Deodar and Kail Forests :*

Deodar (*Cedrus deodara*) and kail (*Pinus wallichiana*) are generally found mixed. Both the species are worked under one system. However, these are worked under the shelterwood compartment system in Jammu & Kashmir where they are found in large quantity. The rotation is fixed at 150 years with 75 cm of exploitable diameter. These have 5 periodic blocks. In Uttar Pradesh these forests are worked under group selection system and under Indian shelterwood system.

Group 13. *Himalayan Dry Temperate Forest :*

This group is situated in the upper regions and inner valleys and does not contain trees of commercial importance.

Group 14. *Sub-Alpine Forests :*

These are not worked at all.

Group 15. *Alpine Scrubs :*

These forests are not worked at all.

Group 16. *Dry Alpine :*

These forests are not worked at all.

CEDRUS DEODARA

Top Height
in Metres

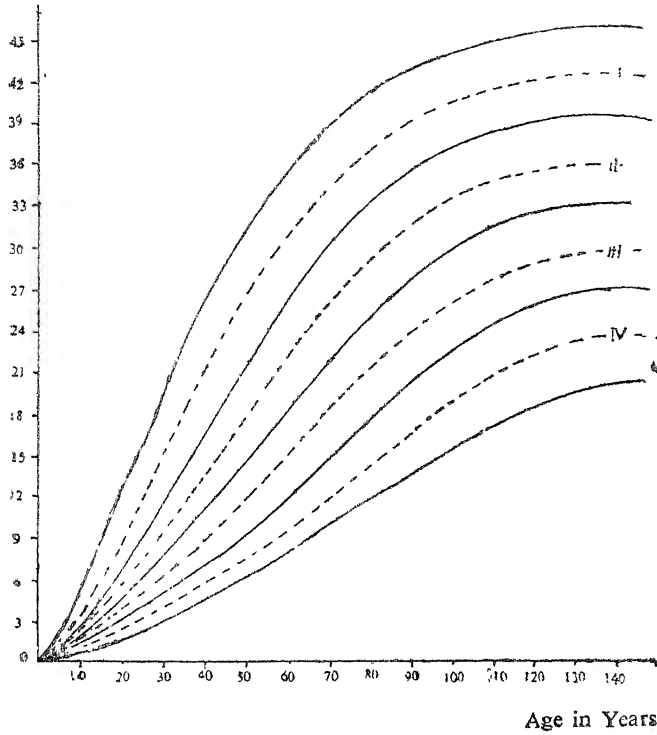


Fig. 19

CHAPTER 14

The Concept of Sustained Yield

Introduction

The belief that forests were inexhaustible paved the way for their destruction. Forests were regarded as an obstacle to development. In case they proved an asset, lavish use was the order of the day. Even after this type of reckless destruction, about 60 per cent of the world forest resources are still virgin due to their inaccessibility.

Formerly forests used to be managed for purposes of game but the timber famine, resulting from destruction of forests to feed the war supplies during the 17th century, compelled the people to change their attitude and practice of forestry management for wood in Central Europe. This fact led to the belated birth of modern forestry.

But it was not until the middle of the eighteenth and beginning of the nineteenth century that the principles of forest management began to be fully expounded and established in Europe to succeed the silvicultural and managerial success of the *Tire et Aire* methods that had been practised in France in hardwood high forests, since the sixteenth century. German foresters (Ottelt, Georg Hartig and Heinrich von Cotta) then propounded the organization of silviculture to provide sustained yields of the produce desired in the most practical method and for financial advantage.

The art of forestry is based on scientific information applied to management of forests with due regard to economic and social considerations. Biology, mathematics, engineering and philosophy—all have a great role in making forestry a successful art. Forestry has now developed into a profession requiring special training on account of all these complications. It deals with the production and exploitation of good services—all possessing social, economic, tangible and intangible values. It can convert anticipated returns into present worth.

Modern forestry is based on two important aspects (1) multiple use and (2) sustained yield. When forests are managed

for more than one purpose the practice is called multipurpose forestry, for example, production, watershed protection and recreation. It is impossible to maximize yield from them in the light of natural environment and of economic and social consideration.

Wood had many important uses without which the pursuit of the aims of life, as it was then seen, was extremely difficult if not impossible. Forests provided wood for fuel, housing, ship building, new industries that were gradually developing, and for waging wars. There was a constant threat of wars breaking out and the wood was not available from foreign countries and if available, it was too bulky to be transported easily. Naturally every nation had an instinct to be self-reliant in wood resources. Forests were needed perpetually to achieve this end. It was necessary to fell the wood in the forests in such a way that future supplies might be secured. It was presupposed that timber would be needed for all times to come and similarly it had been needed so far. The forest property was, therefore, looked at as capital which should be managed in such a fashion that only the interest accruing on it be used periodically, keeping the capital intact. Apparently, this was the origin of the concept of 'sustained yield'. It was considered an ideal way of perpetuating forests. The capital or "growing stock" would have to be maintained to obtain the required volume of wood viz. interest or "yield" subject to its being maximised. If looked at the equilibrium state these interests would be equal. Under this system the annual production of the required volume was ensured perpetually from a given piece of forest land. The volume produced was named as "sustained yield". The maintenance of "growing stock" was required in a particular fashion. The composition of age classes and their volumes were needed in a certain proportion which may give the annual or periodic increment. The growing stock was known as the "Normal forest".

Haley¹ has traced the history of sustained yield in Europe and North America in details. The shortcomings of the

¹Haley, D., 1966. An Economic Importance of Timber in the United States Miscellaneous publication 941. United States Department of Agriculture. Forest Service. Washington, D.C. 91 pp.

unquestioning acceptance in the context of contemporary situations have been discussed by Haley¹, Waggener² and Thompson³. Sustained yield has claimed a number of benefits. However, many of them do not depend on production of equal annual or periodic harvests but they are resultant from continuous forest production—Haley¹.

Waggener² assumed the following factors while taking into consideration the sustained yield :

- (1) It is necessary to have stable flow of wood products *ad infinitum*.
- (2) Each unit of forest land is treated as a closed economy.
- (3) Labour and capital are not scarce in comparison to forest land and forest products.

These assumptions do not seem to be realistic any longer. It may be seen that the population doubled and GNP quadrupled between 1920 and 1962. the consumption of timber products at home remained more or less constant and per capita of wood (exclusive of firewood) declined nearly 50 per cent in the United States of America. Every body knows that changes always occur in the market for wood products, in the technology of production, and utilization standards, and also the cost structure of the forest industries in almost all developing countries. The assumptions underlying "sustained yield" turn wrong in such cases. Such assumptions can be true for an stagnant economy. In such economies, population increases at a fast rate of growth, per capita income and technology have a tendency to remain constant. There exists no trade on account of which every relevant thing remains unchanged. "Sustained yield" suits these economies very well. However,

¹Haley, D., 1966 An Economic Appraisal of Sustained Yield Forest Management for British Columbia. Unpublished Ph D. thesis, Faculty of Forestry, University of British Columbia, Vancouver. 313 pp.

²Waggener, T R., 1966 The Federal Land Grant Endowments: A problem in Forest Resource Management Unpublished Ph D. Thesis, College of Forestry University of Washington, 180 pp

³Thompson, E F., 1966 Traditional Forest Regulation Model: An economic critique. Journal of Forestry, 64 (11), 750-2

it is not justified for those economies which are expanding or wish to grow at a fast rate.

The Meaning of Sustained Yield

If supply of the desired produce is regular or continuous to the full capacity of the forest, it is known as "sustained yield". This definition includes all products from forests. viz. the tangible and the intangible, amenity and protection, major products (wood) and also minor products. The supply of all products can be optimised and planned to the best advantage of each through the principle of "sustained yield". The supply from each forest area should be accounted separately. This facilitates each individual area to be worked on "sustained yield" basis. In case several products are to be supplied from one area, the production and yield of some commodities may interfere with those of other products. However, it is possible to get "sustained yields" from all yet the individual yields may differ in quantity and value from the potential yield of each separately.

The value of "sustained yield" for intangible and tangible forest product is more or less equal. Minor products such as edible fruits may be valued equal to the major products such as firewood. This chapter deals with major products as well as their value but, *mutatis mutandis*, the yields of other produce also applies. The multiple use of forests is very important to remember.

Types of Sustained Yields

There are three ways to get "sustained yields" as follows :

- (1) Integral yields are those which can be collected by clear-felling the whole forest area which contains trees of one age group. They are generated at one time after harvesting, viz once every sixty years.
- (2) Intermittent yields are those which can be collected from several age classes of trees. In this case the timber ripens for felling at regular intervals of several years.
- (3) Annual yields are those which can be harvested by felling trees on yearly basis.

However, "sustained yields" usually mean annual sustention.

Factors Affecting Sustained Yields

"Sustained yields" are the results of sustained efforts in production, i.e. sustained growth of crop. This in turn depends on maintenance of fertility of the land. Regeneration and continued fertility of the soil is the key to sustained yield. Either it is had at regular or irregular intervals or on yearly basis. Irregular periodic yields can be considered to provide a sustained but intermittent yield, if growth of the desired produce is fully maintained. In such a case the production of desired produce is sustained.

Man is never satisfied with his present position. He always tries to improve his standard of living which he is enjoying at present. Thus he will want steadily increasing yields from forest lands. This can be achieved if he can maintain both the sustention and improvement of the crops and the fertility of the land. Then the forest crop needs tending so as to grow the desired produce and regeneration of the crop with the least possible interference from competing vegetation, disease, size or age groups available for felling to suit the objects of management.

Justification of sustained yields

No one can suspect the validity of sustained yield concept. The sustention of yields from forest land and forest crops is needed in its dynamic state. However, sometimes objections to sustained yields, the amount of produce, and, more so, to yields which are specifically regulated to prevent annual or periodic rises and falls in a period of years, can be raised.

Such objections are of recent origin and have brought about a considerable change from earlier thinking which paved the way for sustained yield to carve out an essential place in all forestry theory and practice. Appreciation of change in conditions which apply in many parts of the world, particularly in the industrially developed countries can be done in a better way if change is understood properly.

At the end of the eighteenth century and the beginning of the nineteenth when the concept of "sustained yield" was

developed in Europe, the means of transportation and communications were not so much advanced as they exist at present. The foresters accepted this concept as universally true all over the world. At that time villages as well as towns were largely self-sufficient units. They produced consumable goods locally. Luxuries and a few other expensive necessities could not be made nearly. People were ignorant of power from electricity, oil for heat and light. Coal was not available in remote country places. Wood, though bulky and cumbersome to transport, was counted as necessary for fuel and agricultural uses, nearly everywhere in all walks of life. Locally set up small saw mills provided sawn timber which was regarded necessary for the construction of houses and furniture making. The economy of the community could be interrupted by irregular supplies of wood from a nearby source.

Sustained yield could provide regular employment to people which was considered to be important. The employment position could affect not only the efficiency of forest management but also the welfare of the agricultural community. Irregular yields cause flow in forest work, changes in the quantities of wood felled affect all other work, viz. regeneration extraction, road repairs and silvicultural tending. People liked to go to a job three to five kilometres within the area they lived in. The ever-changing demands for labour not only affected the community welfare but also had to face periodic unemployment which forced migration of labour—a commodity difficult to replace when the need arose.

Industrial markets—sawmilling, turnery etc.—were localized and required continuous supplies of wood from forests. It is difficult to make temporary arrangements for regular supply of wood from distant forests.

Sustained yields were easy to organize. The type of woods required by certain people had remained unchanged for centuries viz., small wood for fuel and agriculture, constructional sawn timber. An increased amount of raw materials was needed for satisfying the needs of growing population, but the pattern of demand seemed to be more or less stabilized. Even the increasing demand for pit-props and the coniferous wood for pulp making did not affect the pattern seriously.

However, after 1861 when the battle of Hampton Roads doomed big wooden ships, England faced the paucity of wood.

The organization of forestry plans in a rigid way was advantageous. The plans were, then, organized keeping in view the sustained yield concept for each forest as a primary function. Later on the forests began to be worked with definite rotations and even-aged stands having separate management units. Small units too could have sustained yields in this system. Even for uneven-aged forests, there was no objection to sustained yield but the position became difficult as to how it should be attained. However, it was understood at that time that the attainment of more or less equal annual yields might take a long time. This would involve some sacrifice in felling stands before or after they were mature. But it was felt that the final goal of sustained yields from each forest was necessary.

Recently two factors viz. transportation and markets, have revitalised the thinking on sustained yields. Of so many developments in transportation, the perfection of the internal combustion engine and improvement of roads are responsible for the greatest effect on forestry. Now trucks could penetrate the felling sites on account of a network of good roads and tracks in developed forests where trucks can be loaded mechanically. Trucks could take the load to markets within a day, say, 100 kilometres away. The markets no more depend on local forest but they could rely on forests within a radius of 100 kilometres.

Men now use bicycles, motor cycles or even cars to go to work in the forests nearly 15 to 25 kilometres while the labourers used to walk 3 to 5 kilometres to go to their work site sixty or seventy years ago. Moreover the contractor or the Forest Department are able to transport the labourers daily nearly up to 30 kilometres in lorries. Thus surplus forest labourers in one area where there is a temporary slump in work, can be transported daily to be engaged in other forests where work is in progress.

Modern market concept also affect thinking on sustained yields in two ways. First is the greater concentration of industry in a particular area which uses forest products. Pulp and paper panel products industries which are usually concentrated at one

place, need large plants, a big output and a heavy consumption of forest products. The sawmilling industry has grown larger, often integrated with pulp mills. Other small users of wood, such as turnery and cooperage works, either have become larger or have disappeared from the scene altogether. These changes coupled with transport facilities, make the forest industry dependent on supplies of raw material from a region or from a very large forest rather than from small individual forests. The industries need sustained supplies of raw materials but from a wider source than it was necessary previously. Moreover the industries now have to depend on imports from other countries.

Foresters have begun to feel uncertain for future owing to changes in recent years in the pattern of demand for small hardwood posts and poles used as raw material to coniferous pulp-wood. However, the coniferous pulp-wood is now giving way to soft-hardwood for making pulp, viz. eucalyptus. European hard-wood coppice forests are already on the way of conversion to high forests, often coniferous. However, technological developments in the field of particle board manufacture will again require a return to coppice. In consequence foresters are required not to plan rigidly. The importance of sustained yield from individual forest remains intact.

Economic Factors

There are two economic objections against sustained yields. Firstly, rigidly regulated annual yields cannot permit an increase in felling areas to enhance the sales of forest produces when prices rise or a reduction in felling cycle when there is a slump in prices. Fellings cannot be adjusted to suit demand. As a consequence the Forest Department or the owner of the forests suffer as the high prices have a tendency to rise high and low prices to fall still lower. Such rigidity in felling is not advisable. It can be overcome by regulating yields over a period of years instead of yearly programme.

Secondly, one of the pre-requisites for getting sustained yield is to have such a forest where trees of different ages and sizes are in the proportion which is necessary to produce a constant sequence of maturing timber. It may be necessary

to husband the stock of slow-growing mature stands for creating such conditions and over mature stands by reduced fellings until young stands mature for final fellings. It would be better to fell the mature stands for realising monetary results and replant them with young seedlings.

The foresters like the sustained yield policy because it is very satisfactory intellectually. Once the forester shapes his woodlands into normal one, he would be getting a constant volume of timber year after year by applying the sustained yield policy. He would need more or less a steady level of staff required to supervise the work, equipment needed and labour to be employed. After achieving this level he will have no worries. He would carry out these operations satisfactorily in perpetuity. The concept of sustained yield appeals to the forestry very well. A lot of difficulties have to be surmounted during the period of "conversion" of the unmanaged forest to a state of normality for realising such a goal. During this period the forester has to determine the rate of "allowable cut" (Forest Club, 1959) which, if allowed, would help the forest to become normal. Practical considerations are taken into account for fixing the conversion period. The allowable cut needs revision from time to time. Books on forest management deal with different methods of determining and regulating the allowable cut, e.g. Chapman¹, Brasnett², Davis³. The cut could be altogether different from the sustained yield which could be removed from the forests after it had been adjusted to normality. But the conversion is done to bring forest to normality, and then the cut is adjusted in such a fashion that it should not vary to a greater degree from year to year. One could hardly afford to have sharp fluctuations in the periodical cut during the conversion to make all cuts to yield an equal amount of produces viz. sustained yield.

¹Chapman, H.H., 1950. Forest Management. Hildreth Press Bristol, Conn. 582 pp.

²Brasnett, N.V., 1953. Planned Management of Forests. Allen & Unwin. London. 238 p.

³Davis, K.P., 1966. Forest Management: Regulation and Valuation. (First published 1954). Mc Graw-Hill, New York. 519 pp.

There are very few forests in the world which have so far become normal and most of them are in conversion period. The world has hardly practised sustained yield. Nevertheless, most countries aim at reaching a stage where sustained yield will be practised. If Waggener's assumption mentioned before, are expected to be fairly realistic, the sustained yield is justified. In case these are unrealistic, the sustained yield goal cannot be justified at any cost.

Though the sustained yield policy may be unjustified, it is relatively very easy to see the reasons to advocate it. One of the reasons is that only foresters were concerned and not the economists with the entire problem some two decades ago when this policy was advocated. However, Zivnуска¹ pointed out the difficulties involved in following a sustained yield policy. Moore² really criticised the objective of sustained yield vigorously. Later Smith³ supported Moore's battle. The forester had been always looking at the problems of forest management from within the forestry sector but the economist looked at them from an outside angle. The economist looked at the forests as a part of the economy as a whole. The fear of scarcity of forests and other natural resources did not frighten him out of his wits. As regards physical scarcity in comparison to economic scarcity, Barnett and Morse⁴ thought that the former was nothing compared to the latter. He realised that other resources could be used to provide the forestry products to society with the help of the changing technology of the contemporary world. Therefore, he thought that physical scarcity of products would not necessarily mean any hardship.

Secondly, the sustained yield goal had been preached by the most distinguished and respected intellectuals, scientists and public men in most advanced countries as being the best

¹Zivnуска, J.A., 1949. Commercial Forestry in an Unstable Economy. *Journal of Forestry*, 47 (1): 4-13

²Moore, M.A., 1957. *Forest Tenures and Taxes*, Tax Paper 11, Canadian Tax Foundation, Ottawa. 315 pp.

³Smith, J.H.G., 1962. Sustained Yield is not Ideal. *Forestry Chronicle*, 38 (2) 167 and 172.

⁴Barnett, N.J. and C. Morse, 1963. *Scarcity and Growth: The Economics of Natural Resources Availability*. Resources for the Future Inc. John Hopkins Press. Baltimore. 288 pp.

possible method of managing forests. The conservation-minded crusaders sold this idea to the common man in the same way as the investor popularises his new product in the market by means of an efficient advertisement. The common man may now be liking the forests just because they are forests.

Unfortunately the people in the developing countries consider every thing happening in the developed countries to be rational and beneficial. They are either incapable of independent thinking or they do not exert themselves to solve most of their problems. Thus most of them adopt a sustained yield policy just because such an act comforts them in their thinking that similar policies are being followed by advanced countries.

Thus most of the advanced as well as underdeveloped nations of the world believe that sustained yield is advantageous, and take this concept as their "sacred cow". These countries derive more pleasure by practising sustained yield than the costs involved in following this concept. According to Udall¹ the sustained yield policy for perpetuating forests cannot be justified from an economic point of view. There is another reason why foresters have remained satisfied and have always justified the sustained yield policy because it has not been achieved in a sizeable area in the world so far. The permissible deviations during the conversion period have been relaxed gradually due to the realities of the economic and managerial life. The phrase — 50 per cent permissible deviation from annual allowable cut, is commonly heard. Moreover it is common to lengthen the period after which the accumulated deviations are averaged. Therefore, no serious hindrance has been noticed in the economic life of the region on account of a sustained yield. Westoby² has suggested that fluctuation from the allowable cut should be averaged out to a small figure after some years. Over and above Westoby² has suggested.

¹Udall, S.L., 1963. *The Quiet Crisis*. Avon Books, New York. 224 pp.

²Westoby, J.C., 1965. An International Perspective on British Columbia's Prospects. Proceedings of Seminar on British Columbia's Future in Forest Products Trade in Asia and the Pacific Area, Feb. 19, 1965. University of British Columbia Vancouver: 121-4.

the goal of "expanding yield". It is not so because "sustained" and "expanding" are two different words but also because the absolute concept of "normal forests" becomes meaningless with expanding yields. Many people have not actually considered this and terms like "expanding yield" and "modulated yield" (Duerr¹) are erroneously thought of as variants of sustained yield. However, their relation with sustained yield lie in as much as they have a denominator of "continuous production".

Since there is no recognition of any other alternative theory of forest resource management, all the other goals are usually put under one roof of "sustained yield". According to Zivnuska² there is an urgent need of having an alternative goal for forestry management. Alternative theories of forest management are lacking greatly on account of which the criticism of sustained yield policy is taken for granted that forests must be cut down haphazardly without future consideration. An intellectually satisfactory theory of forest resource management which can weigh better and more rational against the sustained yield theory has not been developed so far. According to Scoot³ such a theory can be developed on the basis of the user cost concept.

While discussing the future of wood in the existing conditions in the United States of America, Zivnuska⁴ pointed out that the structure of the lumber industry was certainly obsolescent if not completely obsolete for meeting the challenge of modern competition between materials. According to him the lumber industry is expected to lose markets to other materials

¹Duerr, W.A., 1966. Paper read at the 66th Annual Meeting of the Society of American Foresters, September 12-13, 1966. Seattle. Wash.

²Zivnuska, J.A., 1966 The Integration of Forest Development Plans and National Development Plans: How to make the Forestry case at the National Level. Paper presented at the Sixth World Forestry Congress, Madrid, June 1966. N. 6 CEM/G/Pl. 2/3 FAO 15 pp.

³Scott, A.D., 1953. Notes on user cost. *Economic Journal*, 63 (250): 368-84.

⁴Zivnuska, J.A., 1963. The Future for Wood in a Competitive Market. Paper presented at the Joint Meeting of the Columbia River-Puget Sound Sections. Society of American Foresters. Mimeographed. Longview, Wash., May 4, 1963.

as it cannot afford sizeable investments in technological innovations and marketing. He felt that the technology and marketing are improving in plywood and wood-based sheet materials better than lumber. Therefore, they have some future to expand for some time. He also observed that the lumber industry was losing many markets to plywood.

Zivnuska observed that all the forest-based industries, the pulp and paper industry had the brightest future as the research and development programmes are progressing well in this industry. However, plastics, metal foils and other materials were offering a keen competition in established paper markets.

According to Potter and Christy¹ the lumber industry was unable to stand competition from its competitors but the pulp and paper industry stood the test of the time very successfully in the United States. The deflated price of lumber showed a continuous increase between 1870 and 1957, while the per capita consumption and output increased very greatly. Poor marketing and lack of change in technology is mainly responsible for increasing the lumber price while Zaremba² noted that it happened owing to a rise in per capita income.

The sustained yield policy aims at producing timber even if people no longer require it but prefer its substitutes. However, the goal of maximization of present worth is an overall policy while sustained yield is a special aim within this general goal. The policy of maximization of present worth includes the goal of "continuous forest production" if society is to benefit from it.

Concept of Normality

Since the beginning of forest management practices, the doctrine of normality has been universally accepted by the foresters. Despite this widely held belief the word normality

¹Potter, N. and F.T. Christy, 1962. Trends in Natural Resources Commodities Statistics of Prices, Output, Consumption, Foreign Trade and Employment in the United States, 1870-1957. Resources for the Future Inc. John Hopkins Press, Baltimore. 578 pp

²Zaremba, J., 1958. Trend of Lumber Prices. *Journal of Forestry*, 56 (2): 179-81.

may depict a number of different aspects. Normality, in its simplest form, means an even distribution of trees by area of each age or age-class. For example, in a 450 hectares forest on a 45 years rotation there would be ten hectares aged one, ten hectares aged two, ten hectares aged three, and so on. This process would provide 10 hectares of 45 years old crops to be felled and re-stocked.

Practically examining this proposal, a normal distribution of age-class is not likely to give an even out-turn of volume production which might be owing to variations in site and in growing stock throughout the forest. Normality, therefore, precisely implies an equal annual production of wood and can cover production by species and size-classes, normality of annual revenues; normality of annual labour requirements, and so on. However, these definitions are, more or less, incompatible, therefore the word becomes meaningless as long as it is not precisely defined.

The Origin of the Concept of Normality

Though the concept of normality has been in vogue for a long time in forestry it is a strange thing that it has seldom been achieved even after spending huge sums of money in a bid to improve the age-class distribution or to balance the annual production in one way or the other.

The forester aims at moving an abnormal forest towards normality. The usual practice to achieve this goal is to fell the trees either before or after their normal or optimal rotation period. Since fixation of rotation period is the best method to achieve the policy objectives of the forest, any departure from it will incur financial cost. It will be interesting, therefore, to consider why foresters feel the necessity to depart from the optimal treatment of individual crops for the purpose of imposing a way of regularity upon the forest as a whole.

Probably, the answer to this quiz lies in the history of forest management in Europe in the seventeenth and eighteenth centuries, which came in the wake of wide spread destruction of forests owing to increase in population, wars, and industrial development. Establishment of industries like glass making and iron smelting and ever-increasing population depended

upon perennial local supplies when long distance haulage of wood, was impossible over land owing to a lack of the means of transport. The first concern of the foresters, was to conserve and ration supplies to check overcutting and destruction. This safeguard was necessary to regenerate the forests and make them productive continuously. The foresters agreed that the main objective of forest organization was to achieve and to maintain an equal annual volume of production both from the point of view of the users of the wood and the people who worked in the forest. It is noted that the foresters did not care about the financial loss which resulted from abnormal fellings.

Supply and Demand

A major portion of forests in India comprises indigenous species having trees of a heterogeneous character. During the past few decades there has been a world-wide trend towards afforestation and reforestation with exotic species. This has resulted in the creation of forests with a great variety of species, often in pure stand. The afforestation work started in 1951 in India with the advent of the First Five Year Plan and now man-made forests cover more than 2 per cent of forest area. The concept of normality in indigenous forests is complicated because there are a number of species each of which may possess special markets. The concept of normality has little meaning if the forest produces spruce for paper making, eucalyptus for pit props and teak and shisham for furniture making. The normality of production or sustained yield can be a meaningful concept, if it refers to the production for each market.

In the modern times the concept of normality within a forest does not mean anything in a developed country. With the advent of cheap and efficient internal transport one forest may supply raw material to many industries and at the same time many forests may supply to one industry. No industry or community depends on continuous supply of raw material from one forest.

The Concept of work and labour

The normality of yield from a single forest usually has little relevance in the present-day forest management, however,

a normality of labour requirements is significant for practical purposes. So far the forest workers have not enjoyed any economic and social status but it is improving throughout the world. Forest workers now demand full-time employment on perennial basis alongwith accommodation with modern facilities. However, there is no improvement in the working conditions of forest labourers in India. Forest work is becoming highly mechanized, skilled and relatively specialized. Owing to this the productivity of every worker is rising so that the number of workers to perform a certain piece of work is falling. Because of large short-term fluctuations in labour requirements it becomes undesirable. However, there is no difficulty in accepting small yearly fluctuations as well as large fluctuations over long period, viz., retirement and resignation and enhancement of staff by recruitment.

The workers themselves do not comprise the employment problem alone as the number of staff can often be adjusted without much difficulty but it becomes very difficult to provide houses in the forests which occur in the relatively remote areas. It has a dual difficulty, viz. the houses cannot be left empty as they incur financial loss and homeless workers pose a serious threat to management.

Owing to their high versatility, the forest workers can be transferred from cultural to logging work easily. The forest labourers can also be easily transported from one forest to another. But since they have to be paid while travelling, it is not economical to transport them for very long distances. Therefore, it is in the interest of management to avoid large short-term fluctuations in labour requirements of individual forests.

Forest Economy of the World

This chapter deals with the forest economy of the world at large in the sequence of (1) the geography of world forest resources, (2) national forest economics and (3) the international wood trade.

Forest areas

The earth comprises some 13,391 million hectares, excluding 162 million hectares covered by the polar regions. Nearly 40 per cent of the total area, excluding polar regions, is physically capable of bearing a forest cover. Agriculture covers about 25 per cent and the remaining comprises mountain tops, cities, towns, roads, brushlands, and deserts etc.

Of the total forested area in the world, viz. 4,285 million hectares about three-fifths is in the Third World countries. These countries use about 50 per cent of their forest resources for economic progress.

The main body of conifers occurs as a belt around the earth south of the arctic tundra, with projections southwards along the east and west sides of North America and of Eurasia. A small belt of conifers lies in India too. The coniferous forests are of greater industrial value than broad-leaf forests which are more widely spread in the world. The coniferous belt feels the impact of felling more than broad-leaf forests.

South America and Africa have about 40 per cent of the total forest area in the world. U.S.A., Canada and U.S.S.R. together cover about 42 per cent. The forest area in Europe is 3 per cent. It is observed that U.S.S.R., South America and NC America are placed well above average for the world as a whole. Europe, Africa and Asia are placed a little below average while the western Pacific areas are far below the average. Europe lost more area of forests than any other region for the expansion of agriculture.

The accessible forest area in the world is about 59 per cent of which 54 per cent was really in use during the later

half of the 20th century. The following table clarifies the position.

Table-42
World Distribution of Forests by Regions 1976¹

Region	Forest Area of the world (Million Ha.)	Percentage of World Forest Area	Percentage of Region
N C America	750.0	18	40
Europe	144.0	3	30
Asia	550.0	13	26
U.S.S.R.	910.0	21	42
South America	966.0	23	42
Oceania	255.0	5	30
Africa	710.0	17	24
	4285.0	100	

The conifers predominate in cool temperate climate; the northern limits are independent of the severity of winter but with mean July temperature over 50°F (10°C). They also occur gregariously in the tropics where similar conditions prevail in mountainous regions. Though they give way to hardwoods in a more favourable environment yet they have not been completely wiped out except in wet tropics. Coniferous forests are tolerant of low rainfall but like to get heavy snowfall.

Temperate hardwoods are found widely scattered. They are principal trees where the mean annual temperature varies between 40°-65°F (8°-13°C). They need an annual rainfall of 20 inches (51 cms.) with varying amounts of snow occurring in the winter. A few hardwoods, such as birch, extend northwards or upwards almost as far as the conifers.

Tropical hardwoods cling to those regions which are usually free of frost and get annual rainfall of 20 inches (51 cms.) to 80 inches (204 cms.) but a reasonably well distributed rain-

¹Adoped from the Food & Agriculture Organisation of the United Nations, World Year Book of Forest Products 1969-70 and 1976.

fall of at least 80 inches (204 cms.) is more desirable. Good timber can still be produced if rainfall is 30 inches (76 cms.) during four months. If the precipitation is between 20-30 inches (51-76 cms.) the resulting small and stunted trees are only useful for special purposes. Tropical hardwoods occur principally in three great concentrations viz., (1) the Amazon basin, (2) Central and Western Equatorial Africa and (3) Southeast Asia together with the outlying islands. Thus it is clear that large tracts of the earth are open and mostly treeless; central North America, the northern half of Africa and its southern end, the Middle East and the steppes and deserts that extend thence across central Asia, Australia are like a bald head with a fringe around.

Nearly 59 per cent of the world's forest, viz. 2562 million hectares are classified as accessible for timber use, and about 57 per cent of this viz., 1466 million hectares are actually in use. The inaccessible forests are usually located in the remote interior regions of U.S.S.R., Canada and Alaska and in parts of Asia and South America. The accessible forests which are not in timber use are found mainly in Canada, South America and Africa. Most of the forests perform a protective function of high value even if it is being used for producing timber. The recreational use of forests comes next to it. Some countries reserve forests for this purpose. It is estimated that about half of the forests which are not in use for timber production now, are regarded as potential usable tracts for timber production in future.

It seems that the U.S.S.R. had both the largest accessible forest area and area in use. South America commands the second best position in respect of forest area but the accessibility has been restricted to 34 per cent only, of which the area in use is about 9 per cent. In Europe 96 per cent of the total forest area is accessible and as high as 94 per cent of it is in use.

The following table shows the position of the forest areas used for production of timber in the major sub-divisions of the world.

Table-43
Accessible and Inaccessible Forest Area of the World¹
(Million Ha)

Region	Total Forest Area	Acces- sible Forest Area	%age of col. 3 over col. 2	Area in use.	%age of col. 5 over col. 3	Inacces- sible Forest Area	%age of col. 7 over col. 2
N C							
America	750.0	400.0	53.0	400.0	53.0	350.0	47.0
Europe	144.0	138.0	96.0	135.0	94.0	6.0	4.0
Asia	550.0	326.0	59.0	236.0	43.0	224.0	41.0
U.S.S.R.	910.0	910.0	100.0	460.0	50.5	—	—
South America	966.0	322.0	33.4	90.0	9.3	634.0	65.6
Oceania	255.0	76.0	29.8	20.0	7.8	178.0	70.2
Africa	710.0	380.0	53.5	125.0	17.6	350.0	46.5
	4285.0	2562.0	59.0	1466.0	57.0	1722.0	41.0

Leaving aside the regional and national differences in the timber economy there are great variations in the character and management of the forests. One such difference arises out of the contrast between coniferous and broad-leaf species. The conifer or the softwood timber can be termed as general-purpose wood. It is readily used for construction, pulping, and other ends. The broad-leaf species or hardwood is especially suited for limited uses under present technology. For example shisam (*Dalbergia sissoo*) and mahogany are used for furniture making, teak for panelling, oak for flooring and furniture and balsa for floats, carvings etc. Although coniferous forests comprise one third of the total forest area, they form more than half of the area under use for production of timber.

The preponderance of broad-leaf forests in the world as a whole and of coniferous species in the northern hemisphere is striking. South America is specially lacking conifers and they are altogether absent in Africa. Though coniferous

¹Adopted from the Food & Agriculture Organisation of the United Nations, World Year Book of Forest Products 1969-70 and 1976.

species are so little in the world they are in use to the tune of 50 per cent. This is because the consumers prefer to use them in respect of transport, timber fabrication and pulp and also because they occur chiefly in regions of relatively high industrial development. Since broad-leaf species occur in underdeveloped regions where technological progress has not been much developed for their use, these forest species do not contribute much to the economic development of these regions. A steadily increasing utilization of great areas of broad-leaf forests is, however likely to come up with the economic, cultural and technological progress. This is a noteworthy fact that the countries controlling most of the world's tropical hardwoods cover fifty per cent forest area. And these yet potential resources lack development in wood conversion for industrial uses.

Inventory

Statistics relating to the quantity of standing timber in the world are incomplete to a great extent. The figures of growing stock in the world are less reliable as compared with those of forest area. A systematic sampling lacks in the tropics, and methods of estimation vary widely there. According to the F.A.O. estimates the total growing stock in the forests in use is 12,100 million cubic metres with bark.

A low percentage of forests in use indicates that there is a large volume of hardwood forests. For example, South America has 23 per cent of total forest area of the world but the area in actual use comprises 8 per cent of total area of the world. Most of the forests remain unexploited so far. Conifers and broad-leaf forests comprise 55 per cent and 45 per cent of the total growing stock in the forests in use. The average stand comes to 2.55 and 2.41 cubic metres per hectare respectively. The average for all species comes to 2.50 cubic metres per hectare. The stand is considerably higher per hectare in U.S.S.R. than in North Central America. This is because U.S.S.R. has higher proportion of matured trees.

The current and future exploitation depends on the growing stock of merchantable trees and the smaller timber

and young trees that follow the fellings of the matured trees. Therefore an intelligent forest management needs an accurate information on both growing and growth rate. According to the F.A.O. estimates the gross growth with bark is 24,000 million cubic metres in the forests of the world. These estimates are based on the incomplete and often non-comparable information which rests with the F.A.O. This represents 2.4 per cent of the total growing stock in forests in use viz. 45 per cent in conifers and 55 per cent in hardwoods. The estimated growing stock in the forests in India is about 400 million cubic metres of coniferous species and 2,900 million cubic metres of hardwoods. Of these species, more than half are in use in each case.

The net growth which represents the amount of wood actually available for utilisation, is determined by subtracting losses from fire, insects, diseases, wind-storms and other causes, from the gross growth. Natural losses are estimated at about 5 per cent in Europe where climatic conditions are favourable and the standard of forest management is high.

Table-44
Coniferous and Broad-leaf Forests of the World by Regions
(Million Ha.)

Region	Total Forests	Coniferous forests	Percentage of Region	Broad-leaf forests	Percentage of Region
N C America	750.0	500.0	66.6	250.0	34.4
Europe	144.0	85.0	59.6	59.0	40.4
Asia	550.0	110.0	20.0	440.0	80.0
U.S.S.R.	910.0	720.0	79.2	190.0	20.8
South America	966.0	26.0	2.7	940.0	97.3
Oceania	255.0	13.0	5.0	242.0	95.0
Africa	710.0	3.0	0.4	707.0	99.6
Total	4285.0	1457.0	33.8	2828.0	66.2

*Adopted from the Food & Agriculture Organization of the United Nations of the World, Year Book of Forest Products 1969-70. and 1976.

The F.A.O. estimated the annual removal of roundwood (without bark) from the world forest resources in use at about 2524 million cubic metres. This figure is lower than actual removals since it does not include unrecorded and illicit fellings in various countries, for which no official estimates had been made. Industrial wood comprised 53.1 per cent of all removals and fuelwood 46.9 per cent. Conifers contributed nearly 85 per cent of the industrial wood while the rest 15 per cent of it becomes fuelwood.

There has been a substantial change in the pattern of production of wood in the world. In 1960 two-thirds of the total removals of wood came from North America, the U.S.S.R. and Europe but their share has gone down to about 47.9 per cent in 1976.

Of the total removals nearly 86 per cent comprise fuelwood in Africa, 81.6 per cent in South America and 73.2 per cent in Asia. North America consumed a higher proportion of roundwood, paperwood and plywood than any other country. Sawnwood particularly lumber constituted the most important forest product both in volume and in value but its production has been relatively slow after World War II as compared with that of plywood. The plywood production experienced a rise of more than 190 per cent in a period of 12 years while the wood pulp increased more than 162 per cent in the world. The use of fuelwood remains an important forest product in all the regions of the world though it has experienced some decline due to greater use of mineral fuels and hydroelectric power. The recorded fuel production is an underestimate as much of the fuelwood is derived from unrecorded sources such as residues from logging and manufacturing, salvage from buildings and fences. Most of the hardwoods are used as fuel in the world.

The forest resource of the world began to feel the strain due to increased use of wood to meet the expending production necessary with the levels of rising standard of living. According to the F.A.O. the increment and felling were in balance in the 60 million hectares of coniferous forests but the increment in the 54 million hectares of broad-leaf species exceeded that of fellings in the forests in use.

Table-45

Removal of Roundwood from Forests of the World-1976
Million Cubic Metres

Region	P R O D U C T I O N				
	Total wood	Industrial wood	%age	Fuelwood	%age
(1)	(2)	(3)	(4)	(5)	(6)
N C America	518	467	90.2	51	9.8
Europe	306	264	86.4	42	13.6
Asia	719	192	26.8	527	73.2
U S S R.	385	303	78.8	82	21.2
Oceania	30	24	79.2	6	20.8
South America	237	44	18.4	193	81.6
Africa	329	46	14.0	283	86.0
World Total	2524	1340	53.1	1184	46.9

Forest-Based Industry and Forest Product

The total wood harvested and reported to the F.A.O. in 1976 was as follows among major uses:—

Table-46

Total wood Harvested and Reported to the F.A.O.-1976

	World	%age	India	%age
Total removals (Mill. C. Metres)	2524	100.0	130	100.0
Industrial wood -do-	1340	53.1	12	9.2
Fuelwood -do-	1184	46.9	118	90.8
<i>Industrial wood</i>		<i>Percent of Log Volume</i>		
(a) Saw Logs, Veneer Logs		31.8		6.0
(b) Pitprops		1.3		0.8
(c) Pulpwood		13.3		0.8
(d) Other Industrial wood		6.7		1.6
		53.1		9.2
Fuelwood		46.9		90.8
		100.0		100.0

The above figures suggest that the wood production in India becomes mostly fuel viz. 90.8 per cent. This is collected from both the recorded and unrecorded sources. Fuelwood

from recorded sources is little less than that of the industrial wood. The rest comes from unrecorded sources which are depleting at a fast rate.

Lumber and pulp are two major forest-based industries which consume most of the industrial wood in the world. These industries are concentrated in North Temperate Zone of the world. The tropical hardwoods are underutilised while most nations of the world rely upon softwood resources in general. Europe, North America and U.S.S.R.—predominantly coniferous regions contain two-fifths of the forest land and one-third of population of the world. Yet it is interesting to note that their timber harvest touches 48 per cent of all timber, industrial wood 78 per cent of the lumber and manufacture nearly 95 per cent of the wood pulp in the world. The case of firewood is equally interesting, as it is a universally known timber product. Wood has been recognised as an essential ingredient for burning and creating heat all over the world. Though the F.A.O. accords the first priority to firewood, it is not an easy job to collect authentic statistics for the various nations. Therefore it can be concluded that the reporting of production of firewood is relatively incomplete. No doubt this product will definitely exceed that of all other products combined if complete statistics are available. Many underdeveloped nations burn nearly all the wood they produce, viz. Dominican Republic 100 per cent, Timor Port 99.9 per cent, Tunisia 96 per cent, Laos 95 per cent and India 90.8 per cent.

The above discussion gives a sketch of the world forestry and how the situation varies greatly from region to region. This variation is clearly depicted when the nations of the world are grouped according to their economic classes. Economic class I covers all those economies which are highly developed nations, viz. U.S.A., Canada, Australia, New Zealand, Israel, Japan, South Africa and major part of Europe. Economic class III covers all those economies which are centrally planned viz. Albania, Bulgaria, Czechoslovakia, German Democratic Republic, Hungary, Poland, Romania, U.S.S.R., China People's Republic; Korea Democratic People's Republic, Mongolia. Vietnam Democratic

Republic. The rest of the nations of the world are covered under Economic class II which are developing market economies. According to the above classification it becomes rather difficult to describe the forest economies of the nations. For this purpose Duerr¹ has divided the world into seven groups as follows:—

Southern Temperate Nations

This group of nations comprises Argentina, Union of South Africa, and Australia. Their main characteristics are agrarian economy, their countries are lightly wooded, and they have usually borrowed the forestry ideas from Europe as they are bound to the Western Europe by cultural, political and economic ties. There are some strong interests in certain countries in afforesting programmes both for purposes of production of timber and protective measures. The paucity of forest resources and the desire to raise the standard of living compels some countries to become net importers in timber products. South Africa and Australia are regarded as the highly developed forest economies. Argentina is regarded as a developing economy.

Tropical Broad-leaf Nations

The criterion of grouping the nations into tropical broad-leaf is their industrial development. So far their economy was dominated by colonialism but now there is an awakening in them towards liberation. Many of them have already become independent. Such nations have a tendency to export most of their timber in raw form. Firewood forms the major portion of their total wood production. These economies are thickly wooded e.g. French West Africa is covered with forests to the extent of 75 per cent. But most part of the forests in these economies is still inaccessible forest per capita, which is attributable to their sparse population. A noteworthy feature of these economies is that there exists a number of variety of tree species. Indonesia grows more than 3,000 different species of timber. The Amazon basin and Malaya grow about 2,500 tree species. But there are few species which have

¹Duerr, W A., 1960. "Fundamentals of Forestry Economics" McGraw-Hill New York.

established qualities and uses. This characteristic makes commercial logging a pick and choose practice. Finally the produce is a very small harvest per acre. On the other hand the timber economy provides enough employment opportunities and per capita income within some of the nations. Most of such economies have undeveloped forestry practices with poor knowledge of timber, silvicultural system, and its utilisation. These economies have great potential of surplus forests.

Savanah and Desert Nations

The third group is known as the Savanah and Desert Nations which are usually industrially underdeveloped/undeveloped. This group mainly comprises the Arab world. These economies are characterised to have less than 5 per cent area under forests. The greatest satisfaction lies in the fact that their per capita consumption of wood remains the lowest of all in the world. This fact makes up for the deficiency of forest area. Thus these economies import wood and wood products to the tune of a bare minimum. All these facts help in keeping their economies at negligible level.

Border Nations

The fourth group is termed as the Border Nations. These are the nations lying on the border line both geographically and economically as compared with the North-Temperate forest regions. These nations are characterised to have little industrial development having dense populations, surviving on land resources. Forests cover nearly 10 to 25 per cent of their geographical area. These nations, therefore, are termed as timber deficit ones. Some of them import enough quantities of forest products. A few of them follow forestry practices borrowed from Europe, for example, Turkey from Germany and India from England. One of the characteristics is their poor growing stock except the reserved forests. This condition is the outcome of a long gestation period for exploitation of wood and a forage to feed the livestock that abound throughout most region. A dense population—both human and bovine—makes it difficult to conserve forest land there. It is more so where climate is marked by long dry seasons having serious problem of flood and erosion.

European Nations

This group comprises countries known as the North-Temperate nations, viz. United Kingdom, Austria and France. We may include Japan in this group. They are highly developed industrial economies. These economies have usually a high percentage of forest acreage. Their output of timber per capita/acre is very large. The consumption of industrial products of forest origin is very high. They are known as European Nations. Most of their forest areas are accessible. They are mainly characterised to have adopted intensive practices of forest management to achieve self-sufficiency due to continued danger of war hovering on them and also to meet heavy requirements of forest products. They produce the highest output of timber per acre in the world at present. They continue a brisk trade in forest products mostly among themselves. As a general rule, the nations situated in the east have a surplus of forest products. This fact makes them net exporters. Contrary to this the nations situated in the west are not able to produce enough forest products to meet their home requirements and thus they become net importers of these products. The importance of wood, thus, increases in the economy of the nations from east to west. Thus France and Germany provide nearly 5 per cent income and employment from forest economy. As one moves towards east the percentage of income and employment rises, viz. Austria, while it is very low in United Kingdom.

Scandinavian Nations

The above group comprises the Scandinavian Nations, and includes Finland. This region relies upon the forest-based industries for its livelihood. This fact is corroborated when we find that forestry and forest-based industries contribute fifty per cent to the national income in Finland while Sweden—a highly industrialised economy—earns nearly one-fifth of her national income from forest industries. The per capita consumption of forest products is very high in these economies and large additional quantities are exported to other parts of the world. An intensive programme of the forest resources backed by social controls, is carried out to meet the requirements of this type of utilisation in the economy.

New-Rich Nations

The New-Rich Nations comprise Canada, United States and U.S.S.R. These regions have abundant forest resources, and are characterised as fast growing industrial complex depending heavily upon timber and forests. The U.S.A. and Canada receive about 5 per cent and 6 per cent of their income and employment from forest resources respectively. The U.S.S.R. and Canada have a large area each under forests but nearly 50 per cent of it is inaccessible at present. This represents a world reserve of softwood. Both the nations have a big surplus of softwood for export purposes. The United States too was a timber surplus nation until recently, and still possesses a potential untapped forest resource in Alaska. A most lavish use of timber among all the world nations have caused depletion of forest resources. Therefore the nations have drawn up programmes best suited to their needs of economic development. These programmes are very likely to put forestry on a sound footing. All these nations are trying to set rational and national goals of forestry. The U.S.S.R. among these nations is having all government controlled forests, viz. a centrally planned economy.

World Trade in Forest Products

Increased activities in exports and imports gave rise to enhanced production of wood products in the world. A special stepping up of the production of processed wood comprising more than three-fourths coniferous sawnwood came to 433 million tonnes in 1976 as against 403 million tonnes in 1975.

The total value of forest products reached 34.7 million thousand U.S. \$ in 1976 as against 28.7 million thousand U.S. \$ in 1975. A noteworthy feature of the exports of forest products is that it quadrupled between 1966 to 1976 viz. 8.5 million thousand U.S. \$ became 31.0 million thousand U.S. \$. The exports of forest products from developing countries were still at much low level.

As regards exports of forest products, Canada with 6.2 million thousand U.S. \$ was happy to hold the first position while U.S.A. with nearly 4 million thousand U.S. \$ enjoyed

Table-47

World Trade in Forest Products—Exports and Imports 1976
('000 Million U.S.\$)

Region	Exports	Imports
N C America	10.3	6.5
Europe	13.5	18.5
Asia	3.6	7.0
U.S.S.R.	2.0	0.5
South America	0.4	0.7
Oceania	0.3	0.5
Africa	0.9	1.0
Total World	31.0	34.7

the second position. In the European region, Sweden with 3.7 million thousand U.S. \$ kept the first place intact while Finland with 2.5 million thousand U.S. \$ was contented with the second position. Germany Federal Republic with 1.3 million thousand U.S. \$ clinged to the third position. U.S.S.R. exported forest products worth 2 million thousand U.S. \$ only. In the Asian region, Japan with 0.5 million thousand U.S. \$ topped the list while Mal Sabah with 0.4 million thousand U.S. \$ occupied the second place. Mal Peninsula with a little less than 0.4 million thousand U.S. \$ retained the third position. In the Oceania region, Australia with 0.4 million thousand U.S. \$ topped the list. U.S.S.R. exported forest products worth 0.5 million thousand U.S. \$.

As regards imports the N C American region, U.S.A. with 5.4 million thousand U.S. \$ topped the list, followed by Mexico with 1.5 million thousand U.S. \$ and Canada with 0.6 million thousand U.S. \$ covered the third position. In the European region, United Kingdom with 3.7 million thousand U.S. \$ topped the list. Germany Federal Republic with 3.6 million thousand U.S. \$ covered the second place of pride. France with 2 million thousand U.S. \$ stayed the third in the race while Italy with 1.8 million thousand U.S. \$ kept the fourth place. Netherlands with 1.4 million thousand U.S. \$ held the fifth position in the trade. In the Asian region, Japan with 4.5 million thousand U.S. \$ held the first position.

Korean Republic with 0.5 million thousand U.S. \$ kept the second place.

The exports of plywood, veneer and roundwood expanded fast in the world. It became the largest single item in the developing countries exports of forest products. The following table indicates the exports value of world trade.

Table-48¹

World Exports Value of Trade of Major Forest Products
('000 Million US \$)

Item	1970	1975	1976
Sawnwood, Sleepers and Boxboards	2.2	3.8	5.2
Veneers, Plywood, Particle boards and Fibreboard	1.2	2.3	2.8
Paper and paperboard	4.3	9.6	10.9
Fuelwood, Pitprops, poles, Piling Posts	—	0.1	0.1

The international trade in timber products has been brisk. Coniferous species comprised the bulk of the trade of the world in sawnwood with U.S.A. the largest exporter. The world trade in broad-leaf species was however, increasing.

The following table gives the production of wood—coniferous and broad-leaf in the world:—

Table-49

World Production of Industrial Wood—Coniferous and Broad-
leaf 1976

(Million Cubic Metres)

Region	Total Industrial Wood	Coni- ferous	%age	Broad- leaf	%age
N C America	467	383	82.0	84	18.0
Europe	264	193	73.1	71	26.9
Asia	192	66	33.9	127	66.1
U.S.S.R.	303	269	88.7	34	11.3
South America	44	15	34.0	29	66.4
Oceania	24	12	50.0	12	50.0
Africa	46	8	17.0	38	83.0
Total World	1340	946	70.0	394	30.0

¹Adopted from the Food & Agriculture Organization of the United Nations of the World, Year Book of Forest Products, 1966 to 1976.

The above table clarifies that N C America, Europe and U.S.S.R. produce the major part of the coniferous wood, in the world, viz. 81.7 per cent. Asia is the main producing region in respect of broad-leaf species. One thing is clear that coniferous woods are more useful than the broad-leaf species in the world. The reason is that all the developed countries are full of coniferous species. As such they developed proper technology for their utilization. But necessity is the mother of invention. Since the world has begun to feel shortage of coniferous woods, proper technology is being developed to use hardwood species. For example Australia has begun to use 90 per cent of its eucalyptus species for pulp and paper making. Japan is presently using nearly 65 per cent hardwood species for manufacturing pulp and paper.

Let us examine the trade prospects in the world.

Use of Softwood and Hard wood

The following table shows the position how the softwood and hardwood are being utilized in the world.

Table-50
Utilization of Softwood and Hardwood 1976
('000 Cubic Metres)

Item	Total	Coni-ferous	%age	Hard-wood	%age
Saw Logs, Veneer Logs, and Logs for Sleepers	802830	576925	71.8	225905	28.2
Pitprops and pulp-wood	366183	266300	72.7	99883	27.3
Other Industrial wood	171116	102520	59.9	68596	40.1
Fuelwood	1184090	172915	14.6	1011175	85.4
	2524219	1118660	44.3	1405559	55.7

The above table reveals that coniferous wood is mostly used for industrial purposes while the major portion of hardwood becomes fuel. The production of hardwood has exceeded the production of coniferous in the world now.

Let us examine this aspect regionwise.

Table-51

Removal of Roundwood from Forests of the World-1976
('000 Cubic Metres)

Region	Coni- fers	Non- Coni- fers	Total- wood	Indus- trial wood	%age	Fuel- wood	%age
N C America	395719	122031	517750	466826	90.2	50924	9.8
Europe	202778	103040	305818	264293	86.4	41525	13.6
Asia	142469	576806	719275	192535	26.8	526740	73.2
U S S.R.	322454	62080	384534	302932	78.8	81602	21.2
South America	30025	207269	237294	43726	18.4	193568	81.6
Oceania	12048	18044	30092	23838	79.2	6254	20.8
Africa	13167	316289	329456	45979	14.0	283477	86.1
World	1118660	1405559	2524219	1340129	53.1	1184090	46.9

The above two tables throw light on some interesting facts. The hardwood production in the world is 55.7 per cent of the total. The fuelwood is 46.9 per cent of the total production in the world. Of this the hardwoods contribute about 85.4 per cent and as little as 14.6 per cent comes from the coniferous resources. The other industrial woods are 6.7 per cent of the total production of the world. Of this 59.9 per cent comes from coniferous stock and the rest 40.1 per cent comes from hardwood resources. Pitprops and pulpwood form about 14.5 per cent of the total production which comprises 72.7 per cent coniferous and 27.3 per cent hardwoods. Finally saw logs, veneer logs and logs for sleepers form about 31.4 per cent of the total production of the world. It comprises 71.8 per cent coniferous resources and the rest 28.2 per cent hardwood resources. Thus it becomes quite evident that the major portion of hardwood resource production is used as fuelwood while coniferous wood is mostly used as industrial wood. It is clear that the hardwoods are worth low with the present technology. It is not because the hardwoods cannot be used for industrial purposes but it is so because they occur in those areas which are not industrially fully developed. The softwoods happen to occur in those areas where industrial development took place in their early stages. Therefore the

technology for their use was invented first. Hardwoods should have found better use had these been the property of highly developed regions.

Newsprint

Newsprint is one of the most important item for the economic development in the world. The following table indicates its production and trade in the world.

Table-52
World Production of Newsprint—1976
(‘000’ Metric Tonnes)

Region	Production	Imports (+)	Exports (—)	Consump- tion	Percent- age
N C America	11056	6228	7112	10172	44.6
Europe	4985	3094	2368	5711	25.0
Asia	3840	613	122	4331	19.0
U.S.S.R.	1390	31	290	1131	5.0
South America	264	429	89	604	2.7
Oceania	481	228	164	545	2.4
Africa	226	124	58	292	1.3
Total	22242	10747	10203	22786	100.0

Let us examine the trade aspects in newsprint in the world. The total production of this commodity in the world stood at 22242 thousand metric tons in 1976. There has not been much of a difference in exports and imports as they stood side by side at 10203 thousand metric tons and 10747 thousand metric tons. The production of newsprint in N C America region stood at 44.6 per cent. Canada produced the highest quantity of newsprint in the world. At the same time it exported the largest quantity of this commodity. The second largest producer was U.S.A. At the same time U.S.A. imported the largest quantity of this commodity. In the Asian region, Japan was the largest producer of newsprint but her share in exports and imports was very little and hence the production was consumed mostly at home. All other countries of this region lived mostly on imports. The production

in the South American region stood nearly at 43.5 per cent of the total consumption there. The production in Oceania region was 481 thousand metric tons. The whole produce was shared by Newzealand 57.2 per cent and Australia 42.8 per cent. However Australia remained a net importer while Newzealand proved to be a net exporter of this commodity. In the European region, Finland produced the largest quantity of newsprint. Sweeden trailed behind and proved to be the next rival. Sweeden happened to be the net importer of newsprint in this region. Finland is the next country in line. As regards exports, Finland tops the list followed by Sweeden. It is noted here that the difference is of degree only as Finland exported 867 thousand metric tons as against 862 thousand metric tons which Sweeden had exported during 1976. Norway exported large quantities of newsprint to clinch to the third position.

World Production and Trade of Pulp

The paper is important because it has many diverse uses in an economy. Expansion of education becomes possible because of paper. It helps in preserving the legacy of knowledge for posterity. The diffusion of literature and science is possible through paper. Packaging viz. Industrial paper is the life and blood of various industries. Trade and commerce depends on paper now-a-day. The spread of education and other social activities coupled with industrial development of the country created a steady demand for paper. Let us examine its production and trade prospects in the world.

Of the total production of pulp in the world, NC America region produced about 53 per cent. However in the region U.S.A. produced 70 per cent of wood pulp to claim first position while Canada with 29.7 per cent of production stayed the second in the list. Mexico produced the rest. Europe produced more than one-fourth of the total production of the world, but her production in respect of other pulp was limited to one-eighth of the world production. The Asian region produced about 14 per cent of the world production but her share was to the tune of 60.6 per cent in the world production of other fibre pulp. China produced more than

Table-53

World Production and Trade of Pulp, by Region-1976
(‘000 Metric tons’)

Region	Wood Pulp and Other Pulp		
	Production	Imports	Exports
N C America	60047	3612	8470
Europe	28573	10074	6401
Asia	16411	1796	176
U.S.S.R.	8522	197	632
South America	2775	388	378
Oceania	1660	234	374
Africa	1131	275	753
Total World	119219	16576	17184

three-fourths of the total production of the region. U.S.S.R. shared about 7.1 per cent of the world production.

As regards the imports, Europe with 61.1 per cent became the largest importer of wood pulp. In the European region United Kingdom with 22.9 per cent topped the list while Germany Federal Republic with 18.9 per cent held the second position. Finland with 13.5 per cent import was the third in the list. Italy with 12.9 per cent held the fourth position.

As regards the exports, it is noticed that it was substantial. Of the total exports, N C America region exported to the tune of 49.2 per cent of the total export of pulp in the world. Canada in N C America region, shared nearly 73 per cent of the export of wood pulp to top the list. U.S.A. with 27 per cent share in export stood the second in the list. Europe shared about 37 per cent in the wood pulp export in the world. In the European region Sweden with 52.5 per cent topped the list of exporting countries followed by Finland with 17.3 per cent. U.S.S.R. exported to the tune of 3.7 per cent of the total export of the world. Oceania region exported to the tune of 2.2 per cent of the total export of the world. In the Oceania region, Newzealand with 98.7 per cent was the main exporter country.

APPENDIX 1

Land Expectation value by Faustmann's Formula

$$S = Y_r \left\{ \frac{1}{1.0p \ r-1} \right\} - T_a \left\{ \frac{1.0p \ r-a}{1.0p \ r-1} \right\} - T_b \left\{ \frac{1.0p \ r-b}{1.0p \ r-1} \right\} \\ - T_c \left\{ \frac{1.0p \ r-c}{1.0p \ r-1} \right\} - T_d \left\{ \frac{1.0p \ r-d}{1.0p \ r-1} \right\} - T_e \left\{ \frac{1.0p \ r-e}{1.0p \ r-1} \right\} \\ - c \left\{ \frac{1.0p \ r-c}{1.0p \ r-1} \right\} - e \left\{ \frac{1}{.0p} \right\}$$

Where

S = Land (soil) Expectation value

Y_r = Value of Final crop (Standing) at rotation age.

r = Rotation

T_a = Thinning in 10th Year (Value of standing trees to be felled during thinning)

T _b =	„	17th	„	„	„
T _c =	„	25th	„	„	„
T _d =	„	35th	„	„	„
T _e =	„	50th	„	„	„

C = Cost of raising plantation (first three years).

e = Annual cost of maintenance, fire protection.

The value assumed are —

Y _r =	Rs. 8,000.00	} X
r =	80 years	
T _a =	187.50	
T _b =	480.00	
T _c =	535.00	
T _d =	1,000.00	
T _e =	1,200.00	
c =	220.00	} Y
e =	2.00	
P =	6%	
S = X - Y		

Now X would work out as :—

Y _r =	8,000.00 × 0.01	= Rs. 80.00
T ₁₀ =	187.50 × 0.59	= Rs. 110.62
T ₁₇ =	480.00 × 0.37	= Rs. 177.00
T ₂₅ =	535.00 × 0.24	= Rs. 128.40
T ₃₅ =	1,000.00 × 0.13	= Rs. 130.00
T ₅₀ =	1,200.00 × 0.06	= Rs. 72.00

Rs. 698.02 or say Rs. 700

And Y would be :—

$$C = 220 \times 1.009 = \text{Rs. } 221\,980$$

$$e = 2 \times 16.7 = \text{Rs. } 33\,400$$

$$\text{Rs. } 255.380 \text{ or say Rs. } 255$$

Hence $S = \text{Rs. } 700 \text{ minus Rs. } 255 = \text{Rs. } 445.$

BIBLIOGRAPHY

- American Forestry Association, 1951. "The Progress of Forestry 1945-50" Washington, D.C.
- Barnett, H.J. and C. Morse, 1963. "Scarcity and growth: The economics of natural resource availability". Resource for the Future. Inc John Hopkin Press, Baltimore. pp. 288.
- Beazley, R., 1965. "Planning and development requirements in forest-land sector of less developed countries". Proceedings" Society of American Foresters, 1965. Detroit, Mich. pp. 79-91.
- Brasnett, N.V., 1953. "Planned management of forests". Allen and Unwin, London pp 258.
- Champion, H G., 1965. "Tropical forestry education" In proceedings of the Duke University Tropical Forestry Symposium, April 21-26, 1965, Bulletin 18, School of Forestry, Duke University, Durham, N.C. pp. 195.
- , S.K. Seth, "A revised survey of the forest types of India".
- Chapman, G.W., 1966. "The role of forestry development in national planning with particular reference to the developing countries in Mediterranean and Near East Region : Paper presented at the Sixth World Forestry Congress, Madrid, June 1966. No. 6 CFM/E/PI. 2/20, pp. 9.
- Chapman, H H., 1950. "Forest management." Hildreth Press, Bristol, Conn. pp. 582.
- Davis, K.P., 1966. "Forest management—Regulation and valuation". (first published 1954). McGraw-Hill, New York. pp. 519.
- Duerr, W.A., 1960. "Fundamentals of forestry economics" McGraw-Hill, New York pp. 579.
- , 1966. Paper read at the 66th Annual Meeting of the Society of American Foresters, September 12-15, 1966 Seattle, Wash.
- Elliot, John E., "Economic planning reconsidered" pp. 55.

- Ferns, H.S., 1960. "Britain and Argentina in the nineteenth century" (Oxford University press 1960) pp. 337-338.
- Forest Prod. Res. Report for 1964-65 in Britain (13-14).
- Food & Agriculture Organisation, "FOR/SF/ND 23-Terminal Report on Pre-Investment Survey of Forest Resources".
- , 1953. "Raw Material for more paper" Rome.
- , 1973. "Guide for planning pulp and paper enterprises" Rome.
- Galbraith, J.K., 1964. "Economic development" (first published 1962) Houghton-Mifflin, Boston pp. 109.
- Gill, T.R., 1963. "Economic development—past and present" Modern Economic Series, Englewood Cliffs, N.J. Prentice-Hall.
- Government of India, 1951. "Explanatory memoranda for the Central Board of Forestry, 7,8,9 May 1951" Forest Research Institute & Colleges, Dehra Dun.
- , 1960. "Indian forest and forest products terminology". *Indian Forest Records* (new series) Silviculture. 10 (6). Manager of Publications, Delhi pp. 215.
- , 1961. "Census of India 1961" Vol. I—Part II B (ii) General Economic Tables, New Delhi.
- , 1961. "One hundred years of Indian forestry". Forest Research Institute, Dehra Dun, pp. 278.
- , 1967. "Commodity transport studies, timber and timber products" Joint Technical Group for Transport Planning, Planning Commission, December, 1967.
- , 1968. "Report compiled at the time of Commonwealth Forestry Conference."
- , 1969-70. "Estimates of National Product." Central Statistical Organisation, Department of Statistics, Cabinet Secretariat, New Delhi.
- , 1972. "Basic Road Statistics—1970-71", Transport Research Division, Ministry of Shipping and Transport, Oct. 1972.

- , 1972. "Report of the Task Force on Forest Resources Survey," Planning Commission, New Delhi.
- , "Indian Railways annual statistical statements 1972-73 and 1976-77".
- , "Supplement of Indian Railways report 1965-66 and 1972 73".
- , 1974. "India's forests", Central Forestry Commission, Ministry of Agriculture & Irrigation, New Delhi.
- , 1975-76. "Classification of area and irrigated area—state-wise (provisional)", Directorate of Economics & Statistics, Ministry of Agriculture & Irrigation, New Delhi.
- , 1976. "Bulletin No. 11", Central Forestry Commission, Ministry of Agriculture & Irrigation, New Delhi.
- , 1976. "National Commission on Agriculture," New Delhi.
- , 1977. "Forestry in India-1973-74" summary tables, Directorate of Economics & Statistics, Ministry of Agriculture and Irrigation, New Delhi.
- , 1978. "Bulletin No. 15," Central Forestry Commission, Ministry of Agriculture & Irrigation, New Delhi.
- Gregory, G R.**, 1965. "Forests and economic development in Latin America: a challenge to the American forestry profession". *Journal of Forestry*. 63 (2): pp. 83-8.
- Haley, D.**, 1966. "An economic appraisal of sustained yield forest management for British Columbia". Unpublished Ph.D. thesis, Faculty of Forestry, University of British Columbia, Vancouver, pp. 313.
- Haver, C.B.**, and Associates, 1961. "An economic analysis of evaluation practices for water resource development", Mimeographed. United States Study Commission, Texas. pp. 172.
- Hirshleifer, J.C., DeHaven and J.W. Milliman**, 1961. "Water supply: Economics, technology and policy". University of Chicago, Press, Chicago pp. 378.

- Johnston, D.R., A.J. Grayson, and T.R. Bradley, 1967. "Forest Planning" Faber and Faber, London.
- Lewis, J.P., 1964. "Quiet Crisis in India" (first published 1965) Doubleday Garden City, N.Y. pp. 383.
- Locklin, D. Phillip, 1972. "Economics of Transportation" 7th edition.
- Manne, A.S., and A. Rudra, 1965. "A consistency model for India's fourth plan", *Sankhya Series B*. Vol. 27, Parts 1 & 2 (Sept. 1965) pp. 57-144.
- Marshall, Alfred, 1930. "Principles of Economics", 8th edition. MacMillan & Co. Ltd., London p. 1.
- , 1947 -do-
- Meade, J.W., 1966. "Competition and oligopsony in the Douglas fir lumber industry", Berkeley, University of California Press.
- Morrison, Herbert, "Economic Planning" pp. 15.
- Moore, M.A., 1957. "Forest tenures and taxes" Tax paper 11, Canadian Tax Foundation, Ottawa. pp. 315.
- Nehru, Jawaharlal, "Strategy and the third plan", pp. 33-34.
- Nurkse, "Capital formation in underdeveloped countries" pp. 58-59.
- Paul Hermann, 1954. "Conquest by man" (New York: Harper & Row, 1953) pp. 11.
- Paul Mazur, 1953. "The standards we raise" (New York: Harper & Row, 1953) pp. 18-28.
- Potter, N. and F.T. Christy, 1962. "Trends in natural resource commodities statistics of price, output, consumption, foreign trade, employment in the United States, 1870-1957. Resources for the future" Inc. John Hopkins Press, Baltimore, pp. 568.
- Prest, A.R. and R. Turvey, 1965. "Cost-benefit analysis; A survey" *Economic Journal* 75 (300); pp. 683-731.
- Ralph, S. Alexander (Chairman), "Report of the definition committee", *Journal of Marketing*, Oct. 1948. pp. 202-217. The 1960 revision of the definition failed to change this definition.

- Reynolds, L.C., 1963. "Economics: Principles, problems and policies in utilizing land resources" (first published 1947) Harper, New York pp. 599.
- Roth, Filibert, 1925. "Forest regulation" 2nd edition, George Wahr Publishing Co. Ann Arbor, Mich.
- Santa Cruz, N., 1966. "The forestry sector in processes of economic and social development and forestry institutions", Address at the Third plenary Session of the Sixth World Forestry Congress, June, 1966. The Institutional Framework for Forestry development, F.A.O.p. 11.
- Sertorius, Peter and Hans Henls, 1968. "Forestry and economic development".
- Sewell, W.R.D., J. Davis and Scott and D.W. Ross, 1961. "Guide to benefit-cost analysis—resources for tomorrow. Queen's Printer, Ottawa pp. 49.
- Scott, A.D., 1953. "Notes on user cost". *Economic Journal*, 63 (250): pp. 368-84.
- Sharma, L.C., 1972. "The forest industry in Uttar Pradesh" pp. 132.
- Singha, J.R., "Working plan for the Saharanpur forest division" Forest Department, Uttar Pradesh.
- Smith, Adam, "Wealth of Nations (1776)", bk. 1, chap. (iii).
- Smith, J.H.G., 1962. "Sustained yield is not ideal", *Forestry Chronicle*, 38 (2) 167 and 172.
- Smith, K.M., 1965. "A practical guide to network planning" British Institute of Management.
- Spears, J.S., 1966. "Forest investments from a Government point of view" Paper presented at the Sixth World Forestry Congress, Madrid, June, 1966. No. 6 CEM/G/Pl. 4/1 FAO, pp. 12.
- Thompson, E P., 1966. "Traditional forest regulation model: An economic critique". *Journal of Forestry*, 64 (11), 750-2.
- Trotter, W.H., 1940, "Manual of forest utilisation".
- Troups, R.S., 1952. "Silvicultural systems" 2nd edition edited by E.W. Jone. The Clarendon Press, Oxford.

Udall, S.L., 1963. "The quiet crisis", Avon Books, New York. pp. 224.

UNESCO, Office of the chief of mission in India.

Waggener, T.R., 1966. "The federal land grant endowments: A problem in Forest Resource Management" unpublished Ph.D. thesis, College of Forestry, University of Washington, pp. 180.

Westoby, J.C., 1962. "Forest industries in the attack of economic development" *Unasylva* 16 (4): 168-201.

———, 1965. "An international perspective on British Columbia's prospects". Proceedings of seminar on British Columbia's future in forest products/trade in Asia and the Pacific Area. Feb. 19, 1965, University of British Columbia, Vancouver; 121-4.

Zaremba, J., 1958. "The trend of lumber prices" *Journal of Forestry* 56 (2): 179-81.

Zivnuska, J A., 1949. "Commercial forestry in an unstable economy" *Journal of Forestry*, 47 (1): 4-13.

———, 1963. "The future for wood in a competitive market". Paper presented at the joint meeting of the Columbia River-Puget Sound sections. Society of American Foresters. Mimeographed. Longview, Wash., May, 4, 1963.

———, 1966. "The integration of forest development plans and national development plans: How to make the forestry case at the national level Paper presented at the Sixth World Forestry Congress, Madrid June 1966. No. 6 CEM/G/Pl. 2/3 FAO pp. 15.

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